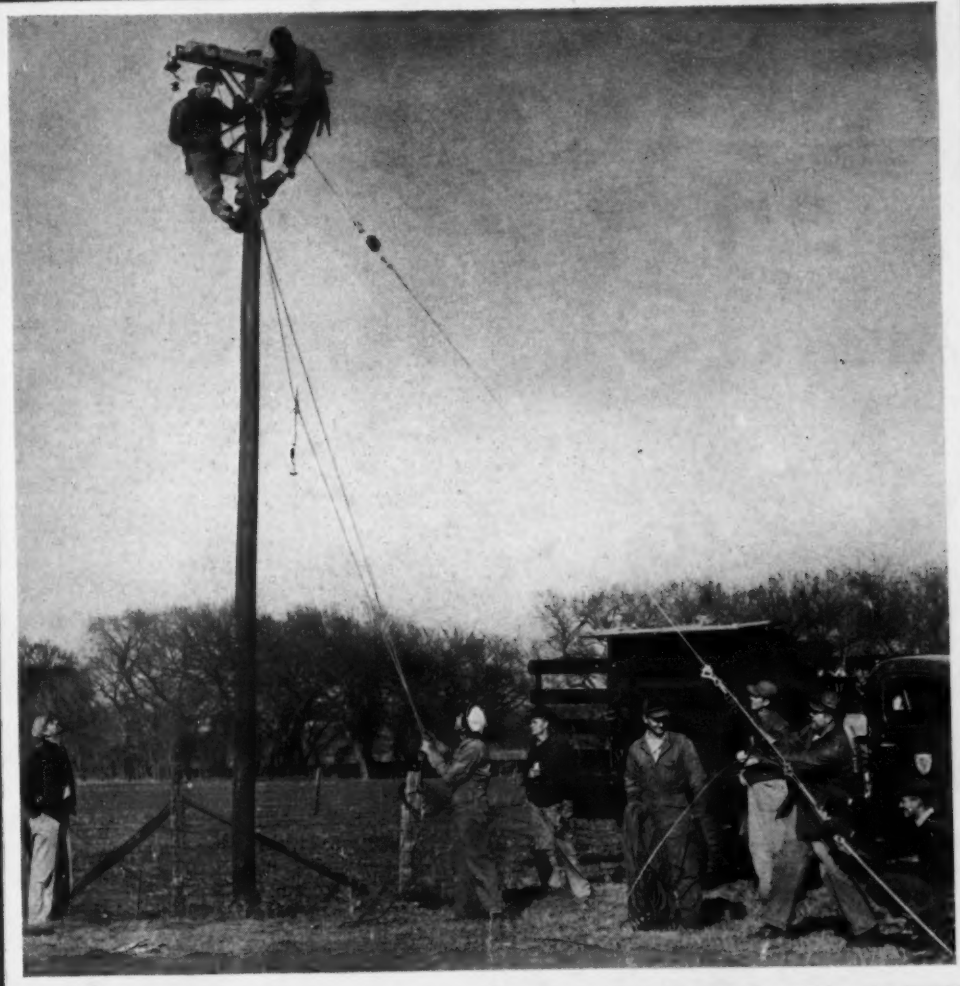
Electrical World



OCTOBER 12, 1946

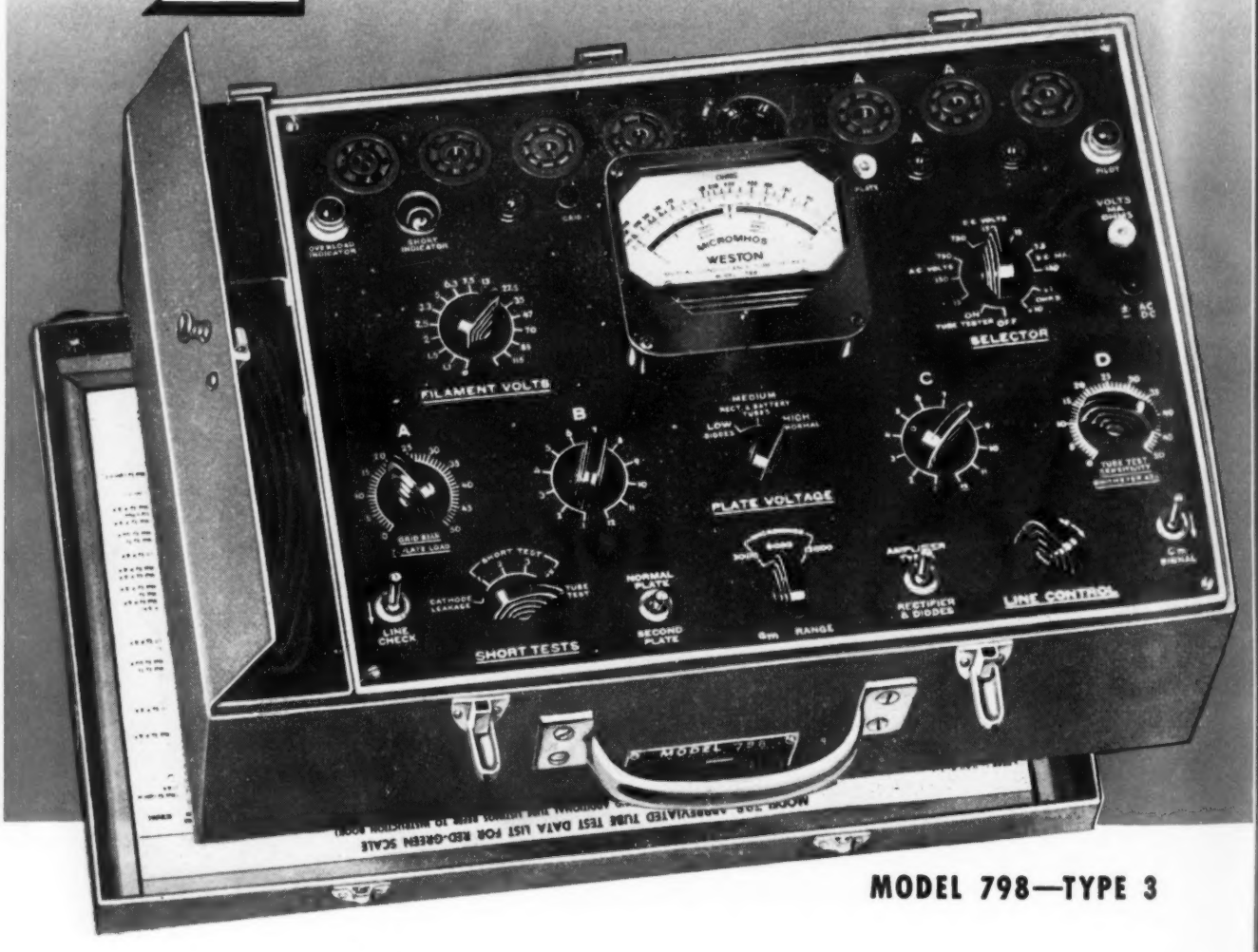
Maintaining Precipitator Performance

Post-Storm Line Repair • Equipment Vulnerability to War

Case for Utility Merchandising • Lineman Training for Veterans

A McGRAW-HILL PUBLICATION

NEW!! WESTON Mutual Conductance Tubechecker and Circuit Analyzer



MODEL 798—TYPE 3

Outstanding Features

- ✓ Direct-reading mutual conductance tests, and "Good-Bad" indications.
- ✓ New patented high frequency tube testing circuit.
- ✓ AC-DC volt-ohm-milliampere ranges.
- ✓ Tests 4, 5, 6, 7 prong octal, loctal, miniature, and acorn tubes...spare octal and miniature sockets.
- ✓ Hot neon leakage test between any two tube elements . . . neon short check.
- ✓ Adjustable plate, screen, grid bias, and signal voltages.
- ✓ Flexibility in switching simplifies testing present and future tubes.
- ✓ Durable heavy-gauge, light-weight alumium case.

Model 798 combines broad utility, ruggedness, and dependable accuracy for maintenance of sound and electronic equipment. Detailed bulletin available. Weston Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey.

Weston *Instruments*

ALBANY • ATLANTA • BOSTON • BUFFALO • CHARLOTTE • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DENVER • DETROIT • JACKSONVILLE • KNOXVILLE • LOS ANGELES • MERIDEN • MINNEAPOLIS • NEWARK
NEW ORLEANS • NEW YORK • PHILADELPHIA • PHOENIX • PITTSBURGH • ROCHESTER • SAN FRANCISCO • SEATTLE • ST. LOUIS • SYRACUSE • IN CANADA, NORTHERN ELECTRIC CO., LTD., POWERLITE DEVICES, LTD.

Electrical World

FOUNDED IN 1874 • READ BY ELECTRICAL MEN FOR 72 YEARS

October 12, 1946 — Vol. 126, No. 15

Contents

This Week's Cover Picture
War veterans learn how to install a guy in the field as part of the training course for apprentice linemen described on page 82.

Post-Storm Rehabilitation of Distribution System 70
P. J. CARLIN, Florida Power & Light Co.

Factors in Maintaining Precipitator Performance 74
O. E. FAWCETT, West Penn Power Co.

Mechanical Stress Relief in Transmission Lines 77
J. N. SWARR, Chase Brass & Copper Co.

Automatic Assembly Gives Watthour Meter Accuracy 79
FREDERICK STRATTNER, Philadelphia Electric Co.

Equipment Vulnerability to War Damage Measured 81
G. V. HARRAP, City of Norwich, England

Lineman Training Course Combines Class and Practice 82
R. F. DANNER, Oklahoma Gas & Electric Co.

The Case for Utility Merchandising 85
P. C. SPOWART, Seattle City Light

Editorials ..... 69 and 86

Washington Comment 88

News of the Week 89

HOW 97

Engineering Reference Sheets ..... 108, 110 and 112

Digests 122

Load Building 130

New Equipment 138

Catalogs and Bulletins 149

News About People 156

Manufacturers and Markets 168

Index of Advertisements 180

SAMUEL B. WILLIAMS ..... *Editor*
DANIEL T. BRAYMER ... *Managing Editor*
ARCHER E. KNOWLTON .. *Associate Editor*
FRANK R. INNES ..... *Associate Editor*
RICHARD N. LARKIN .... *Associate Editor*
RUE M. SHOOP ..... *Assistant Editor*
JULIUS C. MEIER .. *Manufacturing Editor*
KENNETH K. KOST ..... *News Letter*
EDNA M. GLENNON . *Assistant News Editor*
FRANK E. SANFORD ..... *Western Editor*
HOWARD S. KNOWLTON — *New England Editor*
WALTER C. HESTON . *Pacific Coast Editor*
DONALD D. HOGATE — *Manager, Washington Bureau*

ECONOMICS DEPARTMENT
DEXTER M. KEEZER ..... *Director*
WILLIAM F. BUTLER
SANFORD S. PARKER
JOHN D. WILSON

LEE H. HILL ..... *Publisher*
M. S. MacNAUGHT ..... *Manager*
W. W. GAREY ..... *Assistant Manager*

WORLD NEWS BUREAU ... John Chapman, Director. Howard Whidden and Frederick Brewster, London; Michael Marsh, Paris; John Christie, Berlin; Frank E. Frank, Prague; Robert Magidoff, Moscow; A. W. Jessup, Shanghai; Joseph VanDenburg, Bombay; Ernest Hediger, Mexico City; Russell F Anderson, New York.

The contents of this issue are copyrighted and may not be reproduced without the permission of the copyright owners.

ELECTRICAL WORLD

Published weekly. Price 35 cents a copy. Publication office 99-129 N. Broadway, Albany 1, N. Y. Allow at least ten days for change of address. Address communications about subscriptions to J. E. Blackburn, Jr., Director of Circulation.

RETURN POSTAGE GUARANTEED

Subscription rates: In the United States, $6 a year, $9 for two years, $12 for three years. Canada $7 for one year, $11 for two years, $14 for three years (Canadian money at par.) Pan-American countries $15 for one year, $25 for two years, $30 for three years. All other countries $20 for one year, $30 for two years, $40 for three years. Please indicate position and company connection on all subscription orders. Entered as second class matter November 16, 1936, at Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in the U. S. A. Contents copyrighted, 1946, by McGraw-Hill Publishing Co., Inc. All Rights Reserved. Branch Offices: 520 North Michigan Avenue, Chicago 11, Ill.; 68 Post Street, San Francisco 4; Aldwych House, Aldwych, London, W.C. 2; Atlanta, Ga.; Boston, Cleveland, Detroit, Los Angeles, Philadelphia, Pittsburgh, St. Louis, Washington.

McGRAW-HILL PUBLISHING CO., INC.
JAMES H. McGRAW
Founder and Honorary Chairman

Publication Office ..... 99-129 N. Broadway, Albany 1, N. Y.
Editorial and Executive Offices .... 330 West 42nd St., New York 18, N. Y.
JAMES H. McGRAW, JR. ..... President
CURTIS W. McGRAW ..... Senior Vice-President and Treasurer
JOSEPH A. GERARDI ..... Secretary
NELSON BOND ..... Director of Advertising
EUGENE DUFFIELD ..... Editorial Assistant to the President
J. E. BLACKBURN, JR. ..... Director of Circulation

Member A.B.P. — Member A.B.C.
Cable Address McGRAW-HILL, New York

Okonite backs up your own Adequate Wiring and power promotions by sponsoring this and other messages like it . . . in publications used by architects, engineers contractors and others who specify, plan and purchase.

Inadequate Wiring Can Keep Your Plant's Electrical System Unfit for Future Growth

NO ENGINEER would send a small boy to do the work of a husky man. Yet some drift into something that's very much like it . . . into letting electrical systems continue to operate with wiring facilities far short of what they should be.

A good program to prevent such drifting is "More power sources and more power at each source." This is a matter of added electrical outlets — *and much more.* It calls for Adequate Wiring in the broadest sense of the term — wiring not only for present needs but planned to take care of future lighting and power requirements at the lowest cost per kilowatt consumed. Many other precautions help you get full electrical efficiency. You can insist on ample copper in conductors. You can use cables of higher voltages and put unit substations at load centers for greater operating economies. You can correct power factor with such apparatus as synchronous motors and capacitors.

The principle of Adequate Wiring can be applied to improving existing buildings electrically or to making sure that in new buildings there will be no costly renovations, no ripping out of floors and walls. In every stage of your program, you'll find it well worth your while to work with an Okonite engineer, who knows electrical transmission and distribution problems and who draws on his company's experience in the manufacture of insulated electrical wires and cables since 1878. The Okonite Company, Passaic, New Jersey.

OKONITE SINCE 1878

insulated wires and cables for adequate wiring at its best

A FREE ECONOMY IS WORTH FIGHTING FOR

BUSINESS must take the initiative if the price decontrol machinery, set up by Congress, is to be effective. The present price control law is far more than a set of instructions to the administrators of OPA; it is a challenge to business to be aggressive in speeding decontrol decisions and in persuading the Price Decontrol Board to adopt a strong stand for return to a free economy.

Thus far business has not met this challenge. *Two months after the passage of the new price law not a single application for decontrol of a major product had been filed by an industry advisory committee.* This is due in part to the red tape controlling such applications. Nonetheless, a continuation of such inactivity on the part of business can well result in perpetuating price control far beyond the time either the present law or sensible economic policy require.

It was the clear intent of Congress to hasten our return to a free economy. In the legislation continuing the general control of prices, Congress formally declared its purpose to have it "terminated as rapidly as possible."

To accomplish this, the House originally approved a formula which would have made decontrol mandatory when production had attained a prescribed level. The automatic decontrol provision was dropped before the bill was finally passed, partly because of the uncertain effects of strikes on production. But Congress did not mean to return the timing and extent of decontrol to the administrative discretion of OPA.

On the contrary, to assure having price control "terminated as rapidly as possible," Congress created a Price Decontrol Board and gave it power to overrule OPA when the board finds price control should be removed. Moreover, it gave to industry the right and the responsibility to seek decontrol. Also, in a further effort to speed up the decontrol process, it placed narrow limits on the time allowed for board decisions.

Congress had compelling economic reasons for doing its legislative best to speed up decontrol.

1. It is by all odds the best way to eliminate the bottlenecks in production and the black markets which have plagued the country since V-J Day.

   Rigid price ceilings promote shortages of badly needed commodities by discouraging their production. Such shortages both upset the flow of production and promote black markets. At present a considerable part of American industry is stymied by shortage of critical parts and materials. Price control is much to blame.

2. There must be flexibility of prices if a round of new wage adjustments, which may be forced on industry early in 1947, is to be negotiated without grave risks of seriously curtailing production.

   When, under the leadership of the national administration, the first post V-J Day round of wage adjustments was made, price ceilings were held rigid while wages were boosted. The result was a series of price-wage squeezes which upset production. They would have been disastrous if we had not been in a sellers' market, created by a tremendous accumulation of wartime shortages. In 1947, however, many industries will be in a buyers' market. It must be possible, therefore, to have wage increases reflected promptly in price adjustments if we are to avoid a repetition of the costly post V-J Day round of strikes, which often had price control as the key issue.

3. Rapid decontrol is necessary to maintain a high level of employment and production.

   Almost five years of price control inevitably twisted the factors of production and distribution far out of the equilibrium which would prevail in a free economy to which it is the clear purpose of the nation to return. Unless the return to a free economy is facilitated by a speedy and orderly decontrol, the jolt of an abrupt return to competition can be expected to upset employment and production seriously.

It's Up To Business

To encourage speed and boldness in decontrol, Congress provided for the reimposition of control over any prices which, after being released, might

get out of hand. The dangers of this sort are chronically exaggerated. During the 25-day period in July when there was no price control the Civilian Production Administration found that "manufacturers of finished industrial and consumer products have generally exhibited commendable restraint in increasing prices no more than increased costs."

All of this endeavor to speed up decontrol and expand its scope is likely to be futile, however, unless business furnishes the driving power for the machinery Congress provided. OPA certainly will not do it. Neither can the Decontrol Board be expected to go out and drum up cases.

The necessity for vigorous action by business in pressing for decontrol is increased by the fact that the general legislative standards to guide decisions by the Decontrol Board are vague. They must be clarified and sharpened by decisions in specific cases.

The main principle to guide the decontrol of non-agricultural products is that price ceilings shall be removed when supply is in approximate balance with demand. But what precisely does that mean? The meaning will become clear only through Decontrol Board decisions.

The same is true of the principle which makes automatic decontrol of a non-agricultural commodity contingent on whether or not it "is important to business costs or living costs." Business must press cases which will give specific meaning to those vague terms if decontrol is to get on apace.

Cards Are Stacked

At present the government has the cards pretty well stacked against rapid decontrol.

First, the key members of the staff of the Price Decontrol Board are holdovers from the Bowles regime which emphasized the importance of carrying on price control rather than speed in getting rid of it.

Second, in exercising his authority to prescribe regulations to govern petitions for decontrol, the OPA administrator has required excessively complicated statistical and economic data. Manufacturers who are sure they can convince any fair-minded board of the desirability of decontrolling certain of their products assert that they are blocked by statistical entanglements.

Third, OPA has discouraged business from moving immediately under one section of the law to speed decontrol. This section provides that products "not important in relation to business or living costs" may be freed from price ceilings immediately and must be freed by December 31, 1946, unles OPA specifically finds they are important to these costs. Instead of making it possible for business to move under this section now, OPA has issued rules which have the effect of blocking such a course until the end of the year.

In the light of obstacles such as these, it is not surprising that the record of decontrol to date is not impressive.

Decontrol Record

Since June 30 there has been a drop from about 70% to about 60% in the total value of products under price control. But most of the drop has been accounted for by food products, which Congress took the lead in decontrolling, and by industrial machinery which was being decontrolled when Congress acted. By far the larger part of manufactured consumer goods remains under control.

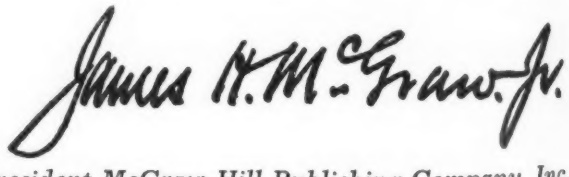
This, however, is no time for business to be discouraged. Rather, business should accept the obstacles put in its way as a challenge and work harder than ever for speedy decontrol.

The case for decontrol should not be stated in narrow technical terms. It should be based on grounds of broad public policy, and should demonstrate how a speedy return to a free economy can hasten the full release of the nation's productive power.

For example, there should be very clear demonstrations of how, in far too many cases, rigid price ceilings—(1) discourage production of key parts and materials by making such production relatively unprofitable, (2) create shortages of key parts and materials which tie up broad ranges of production or result in piling up lopsided inventories of partially completed goods, and (3) thus cut away the foundations of a stable economy and the prospects of steadily sustained employment.

There should be equally full demonstrations of the well known sequence from shortages to unrealistic price ceilings to black markets. Meat prices are rolled back, but the meat is rolled under the counter.

A free economy is worth fighting for. Liberty is preserved only by the constant struggle of those who believe in it. Neither the interests of the nation in a strong and well-balanced economy nor the interests of business itself will be served by drifting at this time. Now is the time for business to lead a strong offensive for speedy elimination of price control.



President McGraw-Hill Publishing Company, Inc.

Electrical World

OCTOBER 12, 1946

On the Importance of Selling

DO PEOPLE buy electricity, as little of it as possible, simply because they need it? Or is it sold to them, to make them want more and more of it?

Many folks, otherwise staunch defenders of business enterprise and loud decriers of government encroachment in other business fields, are in favor of government ownership and operation of electric utilities. They argue that electricity supply is a monopoly of a necessary service and therefore is a legitimate function of government. They accept and advance as dogma, irrefutable and unassailable, the proposition that for the best good of the people a monopoly business should be in government, not private, hands.

As pure theory, there is some virtue in that proposition. But we live in a world of facts, not theories. One fact is that most men expect and demand tangible reward for their work. The greater the hope of reward the harder they will work, the more they will apply thought and enterprise. This is the motive force of progress.

If electric service is simply a monopoly business of meeting a fixed, established need, then it has reached its limits and can progress no further. Thought and enterprise and hard work are required by it no longer; it can just go along performing its function; no more than that is required of it. All it has to do is provide electricity for people to buy according to their needs, and with only that responsibility it is as reasonably a government function as are the provision and maintenance of streets and highways, of police and fire protection, of military security.

But electric service is emphatically not that kind of business. Its potential progress has no foreseeable limits. To maintain, to accelerate, its progress, electric service continually demands energetic thinking, planning and working in advance of the need for it. It must take business risks, must hold out hope of substantial reward for thought and work and money so invested. Specifically it must sell its product in ever increasing volume and be prepared with plant and system facilities adequate to supply that volume.

Such enterprise is not the outstanding characteristic of government in business. There are certain notable exceptions, but the general attitude of government service to the public is "Come and get it if you need it." Power company managements who copy that attitude are inviting government to step in, and it must regretfully be admitted that some are doing just that. They are simply and only monopolies supplying a needed service and they lend substance to the argument that they should not remain in private hands.

But power companies that vigorously sell their services, that seek by every promotional means to bring to the people more and more of the economies, amenities and conveniences of electricity, these companies justify themselves as agencies of individual enterprise, monopolies though they are. They know that selling is the only difference between being damned as monopolies and being liked as progressive businesses. It is the difference between letting people buy electric service and selling it to them.

Post-Storm Rehabilitation of DISTRIBUTION SYSTEM

P. J. CARLIN*, *Superintendent of Distribution, Florida Power & Light Co.*

A FULLY DEVELOPED hurricane usually moves forward at from 8 to 12 miles per hour, but sometimes remains stationary for long periods and occasionally will move forward at as much as 20 miles per hour. It has been our observation that the fast moving storm is less destructive than the slow moving ones and those that remain stationary for any period of time.

These storms are usually circular in shape, causing high winds, 75 to 150 miles per hour, and heavy rains over an area as much as 70 miles in diameter.

The wind blows into the storm center tangentially resulting in a rotary motion around the center in a counter-clock-wise direction. The barometric pressures fall rapidly, reaching a minimum in the storm center.

Character of Storm

Since in the left segment of the storm the movement of the storm is generally in opposition to the direction of the wind, the wind velocities are lower in that segment than is the case in the right segment, where the reverse is true. In the center of the storm a calm exists which may last for just a few minutes or for more than an hour, depending on the storm center diameter, the speed of forward movement and one's position with respect to the actual center. It is naturally very dangerous to start moving around during the lull, since immediately following it are winds of even more destructive force than those that preceded it. It has been our experience that the last half of the storm is more destructive than the first, due to increased wind velocities and to the weakening of structures as a result of the earlier winds.

Rehabilitation Program

Rehabilitation starts long before a storm strikes. Well in advance of a storm season, material needed for restoration is ordered. This year because of the long deliveries and the uncertainty of shipments, we placed orders quite early for considerable quantities of line materials of various kinds.

Due to the difficulty of stocking poles in large quantities and the expense and loss of time of moving poles from one storeroom to another, each year a stock of several thousand poles is laid down in the yards of the pole suppliers. While it is easier to handle crossarms, we also lay down a reasonable stock of arms for shipment to the stricken areas. When threatened with a storm some of these poles and crossarms are loaded and made ready for shipment into the stricken areas as soon as the storm has passed. In order that there will be no delay in restoration work it is necessary that all possible precaution be taken to have all trucks in good condition and to have them well equipped with ample supplies and well maintained tools. To supplement trucks in normal service a stock of tools sufficient for at least ten fully equipped trucks is maintained in a special tool room, which is not drawn on except in case of a storm. These tools are used to stock rented trucks and to supplement tools or trucks brought into the storm area that may not be fully equipped for the work at hand.

Trained Record Keepers

Each year district managers prepare and submit lists of essential customers to whom priority is to be given in event of a storm. These lists include water works, sewage disposal plants, newspapers, radio stations, ice plants, food storage establishments and other institutions having to do with public health and safety. These lists are used by the line department, particularly immediately following the storm.

Since the keeping of records of storm repair costs (some of which are covered by insurance) is important, it is necessary that we have men trained to do this clerical work. Men in various departments of the company are given training prior to the storm season in storm accounting so they may be used in the early stages of rehabilitation work. These men are later replaced by men employed and trained for this assignment. Since it is desirable that we have all line department employees on hand during the hurricane season, vacations of these

CONTRACTOR'S CREWS distributing and setting poles after a 1945 storm

*Adapted from paper before recent meeting of Engineering and Operation Section of Southeastern Electric Exchange in Birmingham.

employees are arranged in late spring and early summer. Efforts are made to get as much tree trimming done as possible prior to the hurricane season, since much damage is caused by inadequate tree clearances. Important maintenance work, particularly any work that would affect service to essential customers, should be completed prior to the vulnerable months. Last but by far not the least in importance, is the organization of the personnel of the line department, particularly the supervisors' group.

Watching the Weather

The approach of a storm is watched very closely. From information obtained from the U. S. Weather Bureau and from barometer, wind direction and wind velocity data obtained from various parts of our system, the course of the storm is plotted. When it appears likely that any part of our system is to be in the path of an approaching storm, managers and supervisors in all departments are kept informed by telephone of its progress. These men proceed to take all possible precautions to prevent or minimize damage to property and interruption to service.

During the early stages of a storm every effort is made to maintain service, particularly to essential and important customers. In some cases unimportant laterals subject to damage are disconnected from main feeders, in some cases temporary repairs are made even under adverse conditions. However, in the path of a severe storm there usually comes a time when it is necessary to deenergize the circuits, in the interest of preventing injury to members of the public and to reduce the amount of permanent damage to facilities. The time for taking this action is usually determined by the manager and the supervisor in each affected district. Usually it is advantageous to deenergize overhead street-lighting circuits in the early stages of the storm, since these circuits are of lighter copper and may break or burn down sooner than in the case of heavier primary conductors. There also comes a time, when it is no longer safe to ask men to climb poles. When this stage of the storm arrives, our men are encouraged to lie down and get as much rest as possible. They are only too glad to follow this advice since most

BREAKFAST for a few of the men at the Miami Shipbuilding Corp. cafeteria which was turned over to and operated by the Florida Power & Light Co.

of them have already been working long and hard and they know that they have many days ahead of them that start with the dawn and may end long after dark.

When it is quite apparent that a certain area is to be hit, forces from other districts that may be considered as immune from damage are marshalled and are given instructions to move into the stricken areas as soon as the storm has passed. These crews come fully equipped with men, tools and materials so that they may go to work immediately upon arrival.

Help from Neighbors

Associated companies and other southeastern companies are advised of our probable need for help in order that they may be prepared to send crews to our assistance when more definite information is given them. In some cases these crews are actually started before the worst of the storm is over, provided we are certain that the storm will cause more damage than can be handled by our own forces. Assistance rendered us in the past has been greatly appreciated and it is comforting to know that such help will be available in the case of future disasters.

As soon as the wind subsides sufficiently to permit men to get out and start work a patrol by troublemen and linemen of circuits serving essential customers, such as water works, hospitals, sewage disposal plants, newspapers and radio stations is started. Any damaged laterals are disconnected, temporary repairs are made to the main circuit in the interest of restoring service to these important customers. Switching maps of each feeder, showing feeders, back feeds, switches and location of essential customers, are used for this purpose. Priority attention is also given to food storage establishments, ice plants, neighborhood commercial areas in the interest of food preservation. While the line forces are working in restoring services to these important customers, the commercial and office forces are busy making a quick survey of the damage of the entire stricken area. This is done by breaking up the territory into small sections in accordance with a predetermined plan. These reports show the number of poles down or broken, number of spans of wire down and other information that can be obtained by this quick survey. In this way, within a few hours after the storm has passed a pretty good idea has been established as to the extent of the damage.

Areas Synchronized

While it is essential that all immediate efforts be devoted to restoring services to customers having to do with the health and safety of the public, it is important also that service be restored to all customers as soon as possible. To accomplish complete restoration with the least delay, it is important that this phase of the work be arranged in an orderly manner. The stricken district is divided into a number of smaller areas. A supervisor familiar with line construction is put in charge of each area, with headquarters in the area, usually at a substation. He is given the assistance of an engineer and one or more commercial representatives. Primary maps of the area are posted on wall

boards or easels at the area headquarters to assist in guiding the repair work to provide a method of reporting the progress of the work. As additional crews arrive from other parts of our system and from other companies, they are assigned to the area supervisors in accordance with their needs. As the work progresses it is usually necessary to shift crews from one area to another.

One of the "must" jobs after a storm is to get debris out of the streets and out of the way of restoration crews. For this purpose we rent stakebody or pick-up trucks and man them with casual labor in charge of men from various departments of our company. These crews clear streets, pick up wire, transformers, etc., cut up and dispose of fallen trees that are in the way of our restoration work, cut down or trim trees for this same reason.

Housing and Feeding

One of the difficult problems, but one of the most important, is to arrange for living quarters for men brought into the storm area and to arrange for facilities to feed them. While some attention can be given to this matter prior to a storm, definite arrangements must be made after the storm has passed. To give some idea of the magnitude of this job it is interesting to note that following one 1945 storm we housed as many as 423 men in eleven hotels and fed 480 men two times a day. Noon-day lunches were provided for 750 men and women.

During the service restoration period much of the work done is of a temporary nature. Permanent repairs are made during this period only in the case of severe damage, and then only in cases where permanent repairs can be made about as quickly as temporary repairs. During the first stages of this part of the work large crews can be used to good advantage, although some small line crews, service crews, and individual troublemen are used for making repairs to light primary lines, secondary buses, services and the fusing of transformers. As the work progresses the larger crews are broken up into smaller crews since more can be accomplished with small crews after the major breaks have been repaired by the large crews. No attempt is made to repair overhead street-light circuits until service is restored to all customers. These repairs are accomplished usually by small crews assigned to individual circuits to repair trouble already logged by patrolmen. These crews are followed by relamping crews that work at night or during the daylight hours, if circumstances will permit energizing these circuits during the day.

Restoring the System

After all service is restored, the long hard job of putting the system back in good condition begins. By this time all crews loaned to us by other power companies have been returned and permanent repairs are started with company forces and with the assistance of contract crews.

Distribution inspectors, usually troublemen, linemen, or other men familiar with the territory and the company's construction standards, make a detailed survey by well defined areas and line and service crews are put to work making repairs as outlined in these surveys. This work is placed in charge of supervisors normally attached to the line department. The length of time required to make permanent repairs depends on many things: the extent of damage, the number of men available, the amount of new construction that must be done. Although permanent repairs were started after the last storm in October, 1945, about twenty-five crews were still working in Miami on storm repairs in early 1946.

Safety Meeting Held

While the regular practice is to have Safety Meetings once a month, during the restoration period short Safety Meetings are held once each week or even more often. They are held at the beginning of the day and are intended to keep the men mindful of safety, to acquaint them of changing conditions and urge upon them the exercise of care and caution. First aid stations are maintained at all crew headquarters in charge of first aid men or nurses.

The use of two-way radio equipment proved to be of great value during our last storm. We had just completed the installation of one 250-watt fixed station in Miami, three 50-watt fixed stations near Miami and 18 mobile units in trouble trucks and supervisors cars. Increased efficiency resulting from this radio communication enabled complete restoration of service several days quicker than would otherwise have been the case. As a result of the experience, the installation of nine additional 250-watt fixed stations and about 60 additional mobile units is contemplated in order to have radio communication in all districts likely to be affected by storm.

Working hours vary during the several periods of restoration work. Immediately following a storm, line forces work as long as they can take it. It is not uncommon for some men to work straight through for as much as 60 hours without rest. However, as soon as help starts to arrive, the work-day is scheduled from dawn to dusk, until all service is restored. During this period Sundays and holidays are just other days. When the

AN EARLY MORNING safety meeting conducted by Distribution Superintendent A. C. Self before beginning the day's rehabilitation work

rebuilding phase of the work begins, a normal work-week of six 9-hr. days is worked until most of the very temporary repairs have been made permanent.

During and following a storm the company is deluged with telephone calls. These calls are answered by trained employees, who make a record of conditions reported by the person calling. At the beginning only those records which indicate possible danger to the public or have to do with service to essential customers are sent to the operating or area headquarters. As the restoration work progresses these records are sent to the area supervisor, who has them worked if they come from parts of his area where primaries have been energized. Methods of handling and filing have been set up so as to avoid duplication on the part of field forces.

Due to conditions prevailing during the four war years, we had fallen way behind in our normal tree trimming and maintenance work. These deferments contributed largely to the extensive damage suffered on light primary lines and secondary buses. With all that, we found the public demanding quicker restoration than ever before.

Lessons Learned

In order that the staff might gain as much as possible from the experiences the president of the company requested anybody and everybody in the organization to submit suggestions on how to improve the performance following a storm. The response to this request was surprising. Many suggestions came from persons in all departments. These suggestions were all examined carefully, studied by executives and department heads singly and in conference. As a result, the company has decided upon many changes in construction practices that when put in effect will reduce the amount of damage from storms considerably.

Many suggestions were made toward improving our public contacts. We found, that while our intentions were to achieve quickest possible restoration of service to all, we had in many ways neglected to keep customers sufficiently advised. We were not in a position to answer customer questions. Definite steps are being taken to provide much better and closer customer contact in the event of future storms in this area.

We found that we were not always using available men to the best advantage. We have become aware of the fact that we can do much more in the form of pre-storm preparation than we have done in the past. With more preparation and pre-storm planning we are satisfied that much of the confusion during the early stage of restoration work can be avoided. To this end much time and thought have been given to the preparation of a Storm Procedure Manual, wherein the organization is set up to function to the best possible advantage. The duties and responsibilities of the various departments and the men in these departments are briefly but clearly outlined. Organization charts indicating definite responsibilities have been prepared. Area supervisors, engineers and contact men will be advised of these assignments in advance of the storm season and they will be given time to acquaint themselves fully with their areas and with their duties well in advance of a storm.

These men, knowing their assignments, will have the chance to discuss among themselves the problems of their particular areas. Men who will be responsible for the patrol and energizing repairs of circuits in the interest of the quickest possible restoration to essential customers will know the circuits for which they will be responsible, and will have ample time to familiarize themselves with these circuits. Above all, the man whose job it is to handle the customer will be supplied as much information as possible and will be given the opportunity of preparing himself for the important task of dealing intelligently with the public, which after all is the boss of all of us in the public utility business.

FORM OF BLANK used to report withdrawals from stores, payroll and vehicle charges for storm rehabilitation work

STORM REPORT

(PAYROLL AND VEHICLE CHARGES, STORES, ETC., REFERENCES)

REPORT No._____

CHARGES ON THIS REPORT ARE IN CONNECTION WITH STORM_____ 19____

DISTRICT_____ SHEET____ OF____ DATE_____ 194____

LOCATIONS AND DESCRIPTION OF WORK DONE (CONTINUED ON BACK)

Franchise Point — Ill. Gas Elec. Light & Power Co. — Limits of

ACCOUNTS CHARGED

HRS. | POR. NOS. | ROS. NOS. | VO. NO. | NAME / VEHICLE No. | OCCUPATION SPEED RUN | RATE

LOCATIONS AND DESCRIPTION OF WORK DONE (CONTINUED)

(4) Franchise Point — Ill. Gas Elec. Light & Power Co. — Limits of

HRS. | ROS. NOS. | POR. NOS. | VO. NO.

(8) Franchise Point — Ill. Gas Elec. Light & Power Co. — Limits of

HRS. | ROS. NOS. | POR. NOS. | VO. NO.

SUMMARY OF INSURED AND NON-INSURED ITEMS

ITEM	COVERED BY INSURANCE POLICY (MO-1)	NOT COVERED BY INSURANCE POLICY (MO-2)
LINE CONDUCTORS—INCLUDING DISTRIBUTION, TRANSMISSION, STREET LIGHT AND SERVICE.	LABOR, CARTAGE, WIRE USED FOR TIES, BONDS AND GROUNDS, SOLDER, TAPE, SLEEVES AND CONNECTORS.	ACTUAL CONDUCTOR
INSULATORS—INCLUDING SPOOL, STRAIN, SUSPENSION AND PIN-TYPE.	LABOR AND CARTAGE	MATERIAL—WHEN USING RACKS, THE POOLS ONLY ARE CHARGED TO MO-2
TRANSFORMERS—POLE TYPE, POWER, AUTO, SUBWAY, AND STREET LIGHT—TESTS, REPAIRS AND REPLACEMENTS. CONCRETE FOUNDATIONS AND SUPPORTS.	LABOR AND CARTAGE	MATERIAL
UNDERGROUND SYSTEMS—TRANSMISSION, DISTRIBUTION AND STREET LIGHT. SUBSTATIONS—STRUCTURES AND ALL EQUIPMENT IDENTIFIED THEREWITH. TELEPHONE SYSTEMS.	LABOR, CARTAGE AND ALL MATERIAL EXCEPT CONDUCTORS, INSULATORS AND TRANSFORMERS.	CONDUCTORS (INCLUDING CABLE). INSULATORS. TRANSFORMERS.
POLES AND ALL HARDWARE—INCLUDING GUYS, BRACES, ANCHORS, CROSSARMS, TOGGLE AND SCREW KNOBS, LIGHTNING ARRESTORS, ETC. PILES AND STRUCTURES AROUND POLES. SWITCHES AND CUT-OUTS. METERS—INCLUDING METER SOCKETS, CABINETS, P.Ts, C.Ts, BOXES AND WIRING.	LABOR, CARTAGE AND MATERIAL	—
REPAIRS AND REPLACEMENTS TO ELECTRIC GENERATING PLANTS, GAS AND WATER PLANTS (INCLUDING EQUIPMENT AND DISTRIBUTION SYSTEMS.) ICE PLANTS, STORAGE ROOMS, OFFICE BUILDINGS, GARAGES AND ALL OTHER BUILDINGS AND CONTENTS, AND STORES MATERIALS WHEREVER LOCATED.	THIS EXPENSE IS COVERED BY INSURANCE, AND SHOULD BE CHARGED TO MO-1.	CONDUCTORS, INSULATORS, AND TRANSFORMERS LOCATED OUTSIDE OF BUILDINGS AND IN SERVICE, TRUCKS AND AUTOMOBILES.
SUPERIOR CONSTRUCTION—AS FOR EXAMPLE, REPLACING 30 FT. POLE, BY 40 FT. POLE IN BLANCA (SEE MANUAL PAGE 30-C FOR ADDITIONAL EXAMPLES.)	ON POR FOR 30 FT. POLE SHOW CHARGE TO MO-1, 144 BL. AND CREDIT TO MO-2 1154 BL. FOR ORIGINAL INSTALLED VALUE. AND SHOW CREDIT TO MO-1, 144 BL. FOR SALVAGE VALUE. CHARGE REMOVAL COST TO MO-1, 144 BL. CHARGE 40 FT. POLE, INSTALLATION, LABOR AND CARTAGE TO MO-2 1154 BL.	
EXPENSES OF RECONSTRUCTION OR REPAIR, SUCH AS FIELD SUPERVISION, TRAVELING AND LIVING EXPENSES, ETC.	THIS EXPENSE IS COVERED BY INSURANCE.	—
COSTS OF STARTING OF REPAIRS OF ACTUAL DAMAGE DURING EARLY STAGES OF THE STORM, SUCH AS CUTTING WIRE IN THE CLEAR, OBTAINING AND ASSEMBLING LABOR AND MATERIALS, LOADING TRUCKS, ETC.	THIS EXPENSE IS COVERED BY INSURANCE. THE SAME AS EXPENSE INCURRED AFTER STORM, AND SHOULD BE CHARGED TO MO-1.	—
COSTS OF PREPARATION FOR PROTECTION OF COMPANY PROPERTY FROM DAMAGE SUCH AS INSTALLING STORM SHUTTERS ON BUILDINGS.	—	THIS EXPENSE IS NOT COVERED BY INSURANCE AND SHOULD BE CHARGED TO THE REGULAR OPERATING EXPENSE ACCOUNTS.

FACTORS in Maintaining Precipitator Performance

O. E. FAWCETT,* *Maintenance Engineer, West Penn Power Co., Pittsburgh*

Clean air in rectifier substation, rotor arms of non-tracking insulation, adequate scraper-chain clearance, ample precipitator capacity, provision for switching spare rectifier, equalized gas distribution are indicated desirable in maintenance studies

PRECIPITATORS fall in the overlapping zones of jurisdiction of the mechanical and electrical forces in the power plant unless clear-cut division of responsibility for maintenance and performance has been set up. When this has been done there is better chance to attain maximum dust-removal efficiency and thus derive maximum benefit from the investment made to minimize the emission from the stack.

In the process of achieving a more thorough check-up of the precipitators at Springdale Power Station several factors were encountered which, when corrected, can contribute to bettered results in dust removal. These pertain to practically all components of the Cottrell installation including the 75-kv. rectifier substation, the transformers, cables, scraper-chain and electrode chambers. Some of these are purely mechanical in nature. Among the electrical features are some that can probably be solved most readily if the analyses are based on readings obtained by means of the Doble power factor testing equipment; these include the high-voltage cables, rotor and stator arms of rectifier, insulators, potheads, etc.

Comments will pertain only to the Cottrell type precipitator which consists of a series of plates, either of reinforced concrete or steel, between which the high-voltage electrodes are hung. These electrodes are groups of parallel wires insulated from and suspended between the grounded plates. Power is supplied at about 75,000 volts d.c. to these inner electrodes. The flue gases pass between the electrodes and the ash is electrostatically deposited on the grounded plates. These plates are regularly cleaned by one of two methods. In the case of the reinforced concrete plates, scraper chains are moved back and forth over the plates to remove ash. In the case of the steel plates, rappers are usually used to jar the deposits, so that they fall into the hoppers and thence into the ash disposal system.

*Adapted from paper at recent Doble Client Conference.

Clean Substation Air

Due to the high-voltage stresses on the insulation within the rectifier substation, including the rotor and stator arms of the mechanical rectifier and the insulators supporting the bus structure, it is necessary to keep these substations clean; otherwise dust deposits may cause flashovers. Two methods of air conditioning are in general use, although undoubtedly other methods are possible and probably are being promoted. One method includes bringing the intake air through glass wool filters. The other method is that of bringing intake air through screens saturated with oil, which operate slowly through an oil bath and continually clean themselves.

The temperature inside a substation cleaned with glass filters will gradually rise after the filters have been changed and is generally several degrees higher than the temperature inside a substation cleaned with oil screens, due to the fact that the glass filters become clogged and the air flow is restricted. In any case, the fan capacity should be such as to keep a positive pressure within the substation. Air conditioning saves appreciably in maintenance cost since the insulation within the substation must be wiped frequently if it is not properly air conditioned.

Earlier forms of rectifier arms had required frequent attention, especially in substations where bad dust conditions prevail. They had to be wiped off every 24 or 48 hours to prevent creepage and subsequent flashover. Modern arms are molded from a material called Melamine. These Melamine arms have a much greater resistance to creepage and under rather bad dirt conditions we have operated them for several weeks without showing the creepage paths which would have shown on earlier arms in a few days. However, the Melamine arms do collect a gummy deposit, and the longer they operate without wiping, the harder this deposit is to remove. We are now cleaning these rectifiers once a week in such substations as have no air conditioning.

Cables and Leads

Some trouble has been experienced with cables. These cables are oil filled and are so installed as to operate under adverse conditions. At some points, the temperatures are high; at other points in the same cable, they are subject to outdoor temperatures. Reservoirs of different types have been installed from time to time to keep the cables full of oil. One company uses a single reservoir for two or three cables and uses nitrogen over the oil. Two or three pounds per square inch seems to be the average pressure kept on the reservoir.

The high-voltage leads are conducted through ceramic insulators above the electrodes shaped in the form of inverted tubs. The top plate of this insulating tub is in two halves, which are cemented in place. Occa-

sionally conditions are such that ash deposits occur within these insulating members and flashovers, due to this built-in ash, may occur. There is always a partial vacuum within the precipitator itself and, therefore, to prevent the ash from building up inside these tubs it is only necessary to remove cement around the top and between both halves of the top plate and allow a stream of air to sweep out the dirt as it tends to deposit.

Of course, some air must then be admitted to the space above the precipitator. This must not be moist air since it would deposit on the insulators and potheads in this chamber. Therefore, air is taken through ducts from the warm space in the tunnel on the roof and allowed to enter this top chamber. A 16-in. duct is now recommended as sufficient to supply all the air necessary.

Scraper Chains

When a scraper chain breaks, it sometimes drops down upon the electrodes, shorting them out and making this section of the precipitator ineffective. Some of the chain breakages are believed due to the operation of the device which moves the chain back and forth over the plates. If the chain catches somewhere, there is plenty of power to break it. This can occur where there is insufficient clearance between the weights holding the chain taut, and the concrete slab, or where there are rough places on the lower part of the concrete sufficient to catch the cleaning chain as it is moved over the surface.

To prevent wear at the point of fastening the high-voltage electrodes to the weights, it has been found advisable to slip pieces of tubing over the electrodes where they go through the eyes in the weights. Indications of burning were found at point of contact of the spring-wire ferrules and the electrode at the lower end.

Precipitator Capacity

Care should be taken that precipitator capacity be ample. It has been calculated that the gas volume at the precipitator inlet is in one case 270,000 cfm. This volume is 25 percent more than the rated volume of 216,000 cfm. For a volume of 270,000 cfm., the efficiency of the precipitator would probably be not more than 85 percent. It has also been calculated that the dust concentration at the inlet is 4.3 grains per cubic foot of gas at standard conditions (32 deg. F. and 29.92 Hg). In this calculation, it was assumed that only 50 percent total ash in the coal fired reached the precipitator and that the inlet ash contained 25 percent combustible material. Under these conditions, the outlet gases would contain 0.645 grains per cubic foot of gas. With this much dust, the stack appearance would not be very good.

Parelleling Spare Rectifier

The Research Corporation recommended and we purchased a spare mechanical rectifier. However, the switching arrangement would not permit paralleling this spare rectifier with any other rectifier in the substation; therefore, it was necessary to drop the load on one rectifier in order to cut in the spare. A means of paralleling the spare was devised so that it could replace any other rectifier without dropping the precipitator and without passing through a grounded point; the plate would hold the charge long enough to prevent dropping the dirt from the grounded electrode. We tried this scheme and found that it worked.

The next thing was to revise the wiring in the substation so as to permit the throw-over switch to throw from one rectifier to another without passing through ground. This was done by relocating the ground jaw and by rearranging the interlock so that it still was effective for the protection of workmen.

Full-Wave Operation

Some time ago, there was a cable failure on the No. 2 precipitator at Springdale Power Station and since that time this unit has been operating full-wave. By observation, it was noted that the No. 2 stack looked better than either No. 4 or No. 6. The question immediately arose as to whether full-wave energizing should not be adopted on the other precipitators. The main objection to such a procedure, of course, lies in the fact that a short from any cause in one section of the precipitator would result in the entire precipitator becoming totally deenergized until such time as the shorted section was cut out of service. On the other hand, when half-wave was used only three

FIG. 1—Grill enclosures provided for component of 75-kv. rotary-arm rectifiers

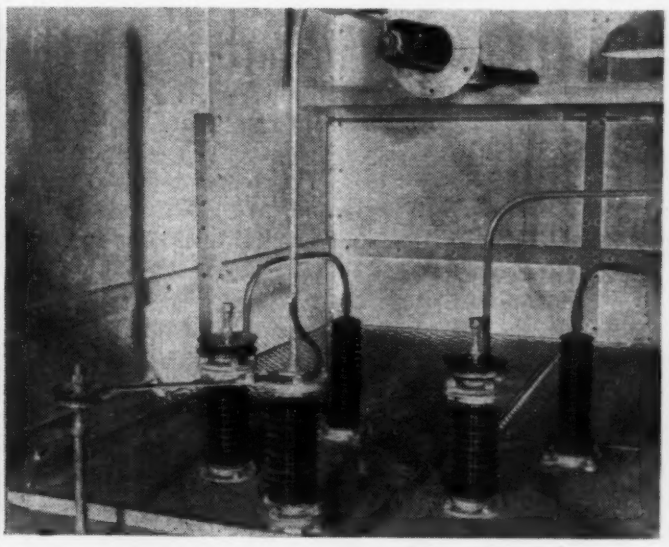


FIG. 2—Ground jaw relocated so spare rectifier can be paralled with one in operation without deenergizing

sections, the ones energized from the same half-wave, would be affected and the other three sections would be doing some good.

With ash having high electrical conductivity, hence, low tendency to arc over, two full-wave electrical sets on precipitators will normally give a small but measurable improvement in recovery over a single set using half-wave. However, with ash of low conductivity and general condition such as vibration, high gas velocities, etc., the tendency to arc over increases and the amount of arc-over actually present may be sufficient to wipe out the normal differential in efficiency between the various hookups with the result that the connection which gives the least arc-over may be the one which gives the highest recovery. However, we have decided on full-wave operation with full knowledge of its shortcomings.

Cable Tests

There are parts of the precipitator which lend themselves to electrical tests; for instance, the transformers and their bushings, the rectifier insulation, the post insulators supporting the bus work and the cables and potheads. Methods of cable test as recommended by the Research Corporation will determine whether a cable is short-circuited or not but will not indicate degree of deterioration unless failure has occurred. It consists of applying about 25,000 volts a.c. from the transformer to the cable with the far end open, taking voltage and current readings on the low side of the transformer and then applying the same voltage with the far end grounded, recording the same data. According to the instructions, if the cable has not failed, the voltage with the far end open will be several times the voltage with the far end grounded. If the cable has failed, these voltages will be nearly equal.

Gas Distribution

In many cases equal distribution of gases through the various sections of the precipitator is not obtained, and consequently there is agitation due to zones of high gas velocity at the top of the vane openings. There may be very little gas flow at the bottom of the opening. The velocity of the gases in the top of the vane opening may be in the order of 20 to 30 feet per second. It is conceivable that these high velocity jets may extend quite far into the precipitator and because of the high velocity, scour collected dust from the concrete plates and thereby re-suspend it in the gas stream. To correct this poor distribution, installation of perforated plates at the inlet to the precipitator is being made. These high velocity jets also cause vibration of the high-voltage elements or electrodes which may become great enough to cause a short circuit within the precipitator. The burning caused thereby may burn off electrodes. Especially this may happen when the scrapers are being used, at which time both the electrodes and the chains are subject to this burning.

Power Factor Tests

There are many parts of the precipitator to which the Doble test would apply if it were properly used and if proper calibrations could be made for the various readings taken. Studies would have to be made at the high temperatures involved to determine what power factor would be permissible, especially on the potheads and bus insulators directly above the precipitator where air temperatures in the neighborhead of 140 to 160 deg. F. may be expected. Also, a study would have to be made to determine whether or not the readings on the cables mean anything when their ambient temperatures vary anywhere from 0 deg. F. or below on part of the run to as high as 140 deg. F. in other parts of the run.

Constructive Comments

The preceding recital of experiences and suggestions has been offered solely to focus thinking on a piece of important and costly equipment which has apparently been taken "for granted." It probably will be necessary for users of electrical precipitators to supplement the general recommendations of the manufacturer with a more detailed and specific test and maintenance program.

Lightning Protection for Industrial Plants

IN A PAPER entitled "Lightning Protection for Industrial Plants," presented at the A.I.E.E. Southern District meeting, Asheville, N. C., the authors, Edward Beck, Protective Devices Engineering Department, and J. Z. Linsenmeyer, Industry Engineering Department, Westinghouse Electric Corp., East Pittsburgh, Pa., present their conclusions as follows:

(1) Circuits in industrial plants, unless they are completely shielded from the effects of lightning, should have lightning protection to safeguard the utilization equipment such as motors and switches. This protection consists principally of lightning arresters and capacitors, located at several points. Theoretically, the best protection is obtained with the protective devices located at each piece of apparatus to be protected. It is believed that in industrial plants where motors are not far apart, adequate protection is obtained with protective devices located at points where surges may enter the circuits and at the remote ends of the circuits.

(2) In cases where the circuits are highly exposed to lightning and where lightning is of appreciable frequency and intensity, shielding of the circuits by overhead ground wires is advisable.

(3) Buildings may be protected from being struck by properly placed rods, masters, or overhead wires grounded to adequate grounds. Such shielding of buildings decreases the hazard of high lightning surges in the circuits.

(4) The transformers that supply power to the plant should have adequate lightning protection. However, lightning protection on the transformers alone will not insure protection to the plant equipment.

Mechanical Stress Relief in TRANSMISSION LINES

Effect of adding towers in spans determined by study of line scale models under laboratory conditions—Application to an operating line

J. N. SWARR, *Chase Brass & Copper Co., Waterbury, Conn.*

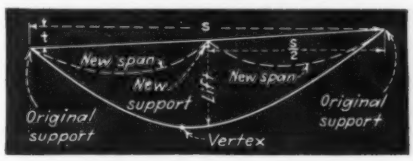
AN EXCESSIVE NUMBER of mechanical failures in an overhead transmission line indicates that the line is exposed to conditions more severe than those assumed when the line was originally erected, so that the maximum stresses exceed those assumed in the design. The problem then becomes one of determining which of several methods of relieving the stress in the wire can be most economically applied.

One obvious method involves adding supporting towers or poles between existing support points of spans. A search in engineering literature was unrewarding in relation to supplying data or method by which the stress relief obtainable as above indicated can be predetermined. Due to the number of variables involved and to the mathematical complexity of the catenary curve, the problem cannot be readily solved analytically. Because of the importance of this problem to the electric utility industry, the consulting engineer of the Chase Brass & Copper Co. (R. W. Shoemaker) decided to establish laboratory facilities for its thorough investigation.

Scope of Laboratory Work

With these facilities it is possible to duplicate any existing line on a reduced scale. Any condition of ice or wind loading can be simulated, tension varied at will, supports added at any point and at any height, and dead-ends located where desired. A method was developed by which the actual tension or stress, with its horizontal or vertical components, can be accurately measured at any point under the scale model line and simply converted to that in an actual line being studied. This method exactly accounts for the stress variations introduced due to elongation of the wire under tension. Besides aiding primarily in the solution of specific problems, the laboratory has yielded considerable data of general value.

The table covers the results of a test, which, though made on an actual line, was conducted primarily to yield general rather than specific information. The term "line" is here intended to mean only the spans included between any two dead ends. This particular line was strung with No. 2 hard-drawn copper. The maximum tension, with ½ in. of radial ice and 8 lb. wind, was half the ultimate strength. The line consisted of 15 towers numbered from 38 to 52. The support numbers given in the table cover the 28 terminals of the 14 spans. Thus, support No. 43R refers to the span terminus on the right-hand of tower No. 43, which is the left-hand end of span 43-44. The tension at each of the 28 points of support is recorded in the column "Original Tension."



RELATION between original span and resulting two spans after adding support midway between ends

The additional data were obtained by adding experimental towers individually in the spans indicated and then measuring the resultant tension at each point of support. The experimental supports were located midway on a straight line joining the two supports of the span into which the experimental tower was added as shown in the sketch. In this case the two new spans are identical and maximum stress relief is obtained. In most cases it is not practicable to locate additional supports in exactly this way, but a study of the data so obtained yields important general information. To consider other locations greatly complicates the problem and may be reserved for a future presentation.

When a support is added in any given span, the stress at the points of support of the original span is diminished due to a reduction in the vertical components at these points. This is referred to as the primary stress relief, R_1. It has been found that R_1 can be calculated with about 90 percent accuracy by the empirical formula

$$R_1 = T_H\left[\frac{AS}{1-Bt/S} - C\right] = T_H\left[\frac{AS^2}{S-Bt} - C\right]$$

where

R_1 = primary stress relief, in pounds, at the highest point of support of the span into which the new tower is added.

T_H = tension, in pounds, which existed at the highest support before the new tower was added.

S = horizontal distance, in feet, separating supports of the original span.

t = difference in elevation, in feet, between the supports of the original span.

A, B and C are constants.

For a line strung with No. 2 hard-drawn copper to one-half the ultimate with ½-in. ice and 8 lb. wind, $A = 6.75 \times 10^{-5}$; $B = 1.75$ and $C = 0.0175$.

t is positive when considering the stress at the higher point of support and negative when considering the lower point. Thus, for the lower support

$$R_1 = T_L\left[\frac{AS}{1+Bt/S} - C\right]$$

where

T_L = tension, in pounds, originally existing at the lower support.

It is interesting to note that where t/S is large, it is possible that the addition of a tower may actually produce a negative primary stress relief at the lower support.

Stress Relief Throughout Line

When a support is added to an existing line, all insulators will swing away from the new support. When all the insulators have been realigned with the vertical, the length of wire in the two spans will be less than that in the single span replaced. In the realignment of the insulators, this additional wire becomes distributed among all the spans in the line with a resultant increase in sag in each span. Obviously then, the stresses at every point in the line are reduced as a result of inserting an additional sup-

Effect of Adding Supports to Actual Line

Support No.	Elevation (ft.)	Original Values		40.5 Added		41.5 Added		45.5 Added		46.5 Added		47.5 Added		49.5 Added		All Six Added Simultaneously		
		Span S (ft.)	Tension T (lb.)	Reduced Tension (lb.)	Relief R (lb.)	Reduced Tension (lb.)	Relief R (lb.)	Reduced Tension (lb.)	Relief R (lb.)	Reduced Tension (lb.)	Relief R (lb.)	Reduced Tension (lb.)	Relief R (lb.)	Reduced Tension (lb.)	Relief R (lb.)	Σ of Individual Reliefs (lb.)	Reduced Tension (lb.)	Relief (lb.)
38 R	693.8	400	1401	1380	21	1270	131	1230	171	1357	44	1365	36	1363	38	441	964	437
39 L	685.0		1394	1370	24	1263	131	1225	169	1348	46	1355	39	1358	36	445	961	433
39 R	685.0	375	1394	1371	23	1263	131	1224	170	1350	44	1357	37	1354	40	445	955	439
40 L	687.6		1395	1374	21	1266	129	1227	168	1353	42	1361	34	1361	34	423	959	436
40 R	687.6		1392	1362	*30**	1262	130	1222	170	1348	44	1354	38	1356	36	448	941	451
40.5 L		350		1362													942	
40.5 R				1361													940	
41 L	690.2		1392	1362	*30**	1263	129	1225	167	1350	42	1356	36	1356	36	440	941	451
41 R	690.2		1392	1369	23	1249	*145**	1223	169	1348	44	1357	35	1354	38	452	938	464
41.5 L		675				1291											987	
41.5 R						1249											939	
42 L	784.8		1491	1474	17	1294	*197**	1335	156	1459	32	1460	31	1460	31	464	988	503
42 R	784.8	275	1386	1364	22	1255	131	1215	171	1342	44	1348	38	1348	38	424	945	441
43 L	790.2		1391	1368	23	1258	133	1220	171	1346	45	1353	38	1353	38	438	951	440
43 R	790.2	240	1382	1360	22	1249	133	1210	172	1340	42	1345	37	1344	38	444	939	443
44 L	810.5		1401	1379	22	1269	132	1229	172	1356	45	1363	38	1363	38	447	958	443
44 R	810.5	285	1390	1367	23	1257	133	1219	171	1346	44	1352	38	1352	38	447	948	442
45 L	808.4		1388	1366	22	1257	131	1218	170	1345	43	1352	36	1351	37	439	949	439
45 R	808.4		1428	1404	24	1304	124	1218	*210**	1382	46	1389	39	1390	38	481	951	477
45.5 L		742						1232									966	
45.5 R								1218									950	
46 L	835.1		1457	1434	23	1329	128	1234	*223**	1415	42	1416	41	1420	37	503	966	491
46 R	835.1		1383	1360	23	1249	134	1210	173	1348	*35**	1345	38	1345	38	441	941	442
46.5 L		458								1396							990	
46.5 R										1347							940	
47 L	929.5		1476	1455	21	1355	121	1303	168	1391	*85**	1438	38	1439	37	470	986	490
47 R	929.5		1401	1378	23	1268	133	1229	172	1356	45	1348	*53**	1363	38	464	944	457
47.5 L		405										1346					941	
47.5 R												1348					943	
48 L	923.6		1396	1373	23	1265	131	1226	170	1352	44	1346	*50**	1358	38	456	942	454
48 R	923.6	295	1424	1403	21	1292	132	1253	171	1382	42	1387	37	1387	37	440	980	440
49 L	877.9		1384	1361	23	1249	135	1210	174	1339	45	1345	39	1345	39	455	938	446
49 R	877.9		1466	1447	19	1333	133	1294	172	1420	46	1429	37	1391	*75**	482	979	487
49.5 L		400												1356			942	
49.5 R														1393			979	
50 L	795.0		1384	1361	23	1249	135	1210	174	1339	45	1345	39	1356	*28**	444	942	442
50 R	795.0	300	1492	1464	28	1351	141	1312	180	1443	49	1452	40	1449	43	481	1030	462
51 L	706.2		1403	1377	26	1266	137	1225	178	1356	47	1363	40	1360	43	471	977	426
51 R	706.2	465	1410	1389	21	1281	129	1242	168	1368	42	1374	36	1373	37	433	946	464
52 L	696.5		1396	1376	20	1270	126	1231	165	1355	41	1363	30	1365	31	413	959	437

Table shows in columns headed "Relief" the differences between the original tension and that obtained after adding support. The values are the total Relief, R_2, in all cases, except that the two values in italics(*) in each column are the sum of R_1 and R_2.

In order to determine the effect of adding several towers in a single line, the table shows the actual tensions and stress reliefs, which had previously been added individually, have now been added simultaneously. As would be expected, the relief obtained equals the sum of the reliefs obtained when the towers were added individually. This makes it possible to calculate by the empirical formula given the relief obtainable by adding more than one tower in a line.

port at any point within that line. This stress relief which appears in every span is termed the secondary stress relief R_2. This can be calculated with 90 percent accuracy by the empirical formula

$$R_2 = T_H\left[\frac{(S - A't)^2}{B'L} - \frac{C'}{L^2}\right]$$

where

R_2 = reduction in tension, in pounds, at any point of support in the line, including the supports of the span into which the tower is added.

L = length of wire in the line, in feet. The data in the table were obtained on a line in which L equaled 5,770 ft.

T_H = tension, in pounds, which existed at the highest support of the span into which the tower was added.

For the particular wire size and stringing tension described above, $A' = 0.20$; $B' = 740$ and $C' = 3 \times 10^5$.

It should be emphasized that the primary stress relief R_1 is obtained only in the span into which a new support is added; whereas the secondary stress relief R_2 is obtained in every span, including that in which the tower is added. The total stress relief obtained in the span in which the tower is added is R_1 plus R_2.

The formulas show that both R_1 and R_2 are proportional to the square of the span into which the tower is added. Thus, the stress relief obtainable by adding a tower in a short span is small, the primary relief actually becoming negative at the lower support if there is an appreciable difference in elevation between the two original supports. This is verified by the data in the table. R_1 was negative at 46R when tower 46.5 was added, and at 50L when 49.5 was added. Therefore, if a line is made up entirely of short spans, it will probably be more economical to employ other means of relief such as restringing with larger wire or with greater sag. If the line consists entirely of long spans, appreciable stress relief throughout will be obtained by adding a tower in any one span.

If a line is made up of both long and short spans, towers should only be added in the long spans. A tower added in a long span will probably give greater relief in any given short span in the line than if the tower were added in the short span. Thus, it is noted that the original tension in tower 49R is high. If a tower is added in span 49-50, a short span, the relief at 49R is 75 lb. If it is added in the long span 41-42, the relief at 49R becomes 133 lb. The formulas can be used to determine into which span the tower should be put for maximum stress relief.

The origin of the secondary relief R_2 would indicate that its magnitude should be inversely proportional to the line length, which is true. Thus the relief obtainable, due to the addition of a tower, can be increased if dead-ends are also added.

The difference in elevation of the two supports of the span into which the tower is added is an important factor. It will be noted from the formulas that as t increases, R_1 increases at the higher support and decreases at the lower support, and that R_2 decreases. R_1 may actually become negative at the lower support.

AUTOMATIC ASSEMBLY
Gives Watthour Meter Accuracy

Photo-electronic method automatically gives visual indication of percentage error on three customary loadings in sequence—Meter automatically deenergized at end of routine or adjustment runs—Master meters compared similarly

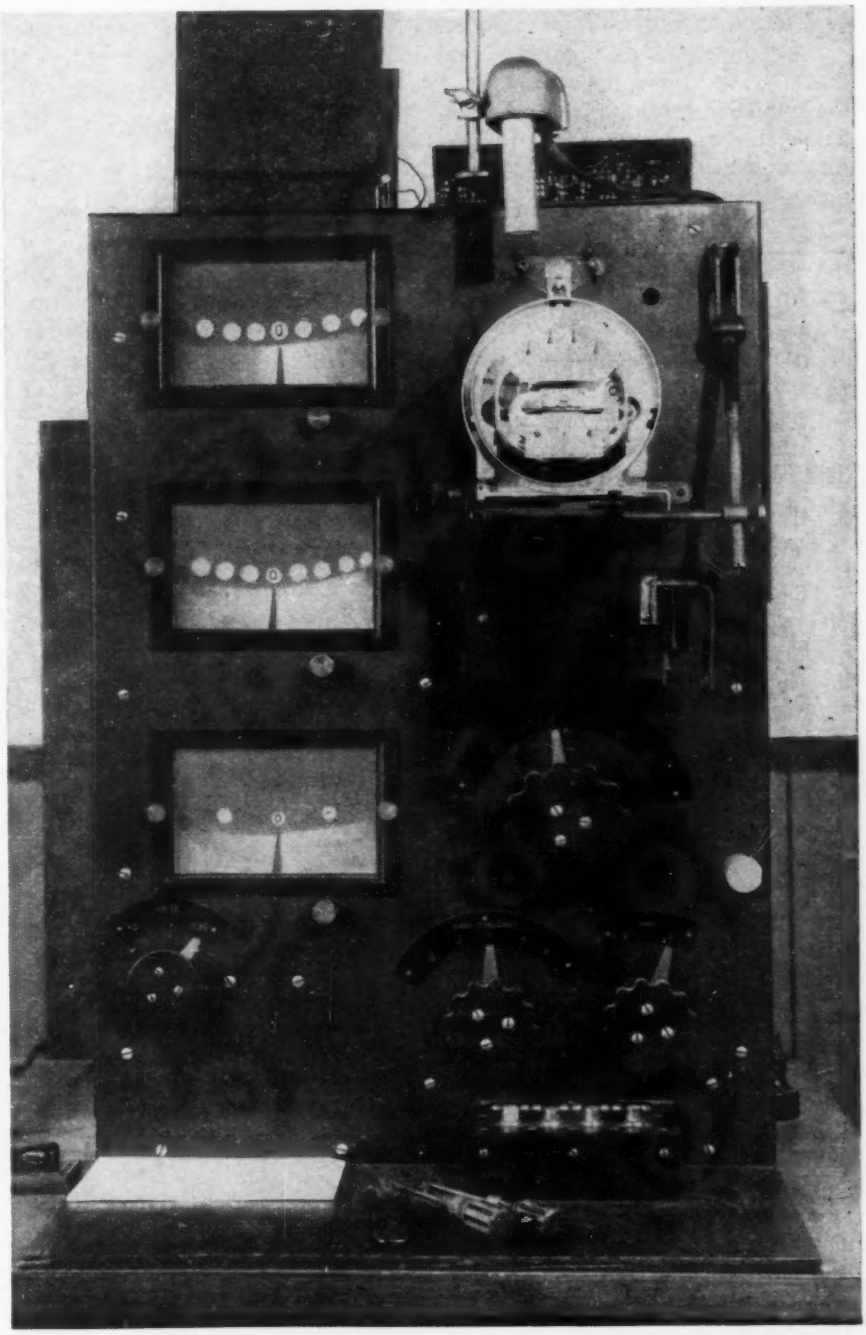
FREDERICK STRATTNER,
Assistant Superintendent, Meter Laboratory, Philadelphia Electric Co.

AUTOMATIC METER TESTING has been brought to a new state of perfection by a machine developed in the meter shop of the Philadelphia Electric Co. A photo-electric cell, a radiotronic amplifying system, and the anticreep holes in the disks of watthour meters enable the meter circuits to be operated without introducing friction, either in the standards or in the meter under test.

Contained in a cabinet approximately 22 by 24 by 30 in. are three watthour meter standards. These are mounted in such a manner that a projection system produces an image of the disks of these standards on a ground glass insert on the front of the panel. Inserted in holes in the periphery of the disks of the watthour meter standards are photographic film transparencies. These are projected on the three ground glass screens shown on the left of the photograph, enabling the operator to determine the accuracy of the meter under test at light, heavy, and inductive loads, as a direct percentage for each test load. The readings remain until the machine is reset by the operator, thus releasing the operator for work on other details while the test run is in operation.

Loading Transformer

A multiple-wound current transformer has its secondary winding connected in series with the current coils of the standard meters and the meter under test. The primaries of this transformer are supplied from a 12-volt loading transformer through proper resistors depending on the



PUSHBUTTON starts test on second passage of creep hole (a) full load, (b) light load and (c) inductive load in automatic succession

rating of the meter under test. Selector switches are provided near the lower part of the panel. These can be set so that any meter may be tested regardless of its basic test constant, its voltage or current rating, or whether it be a 2-wire or 3-wire meter. In all cases the performance of the meter will be indicated directly in "percentage accuracy." Various relays, mounted on the rear of the assembly, do the selective switching automatically, such as starting, stopping, changing load, and changing phase relation.

Four pushbuttons (lower right) control the operation of the machine. The first button starts a sequence run, that is the light load, the full load, and the inductive load run, then the machine stops and completely deenergizes the meter under test. Adjustments, if required, can then be made in perfect safety. A glance at the three screens shows the performance of the meter under test. The three other buttons permit a test on any individual load (either light load, heavy load or inductive). Pressing any button causes relays to reset the standards to zero load and potential is then applied to the meter under test causing it to rotate, and also the proper circuit is selected. In making the test, the machine ignores the first light impulse passing through the anticreep holes of the meter under test, but starts the proper standard on the second impulse. This eliminates starting errors, and permits the meter disk to reach full speed before the test run is started.

Voltage Compensated

A multitap autotransformer permits compensating the voltage applied to the standard for minor variations in the accuracy of the taps on the multiratio current transformer. Inductive load is obtained from a cross-phase connection on the three-phase supply. Leveling devices are provided for the meter under test, and a quick circuit closing device connects the meter under test into the test circuit.

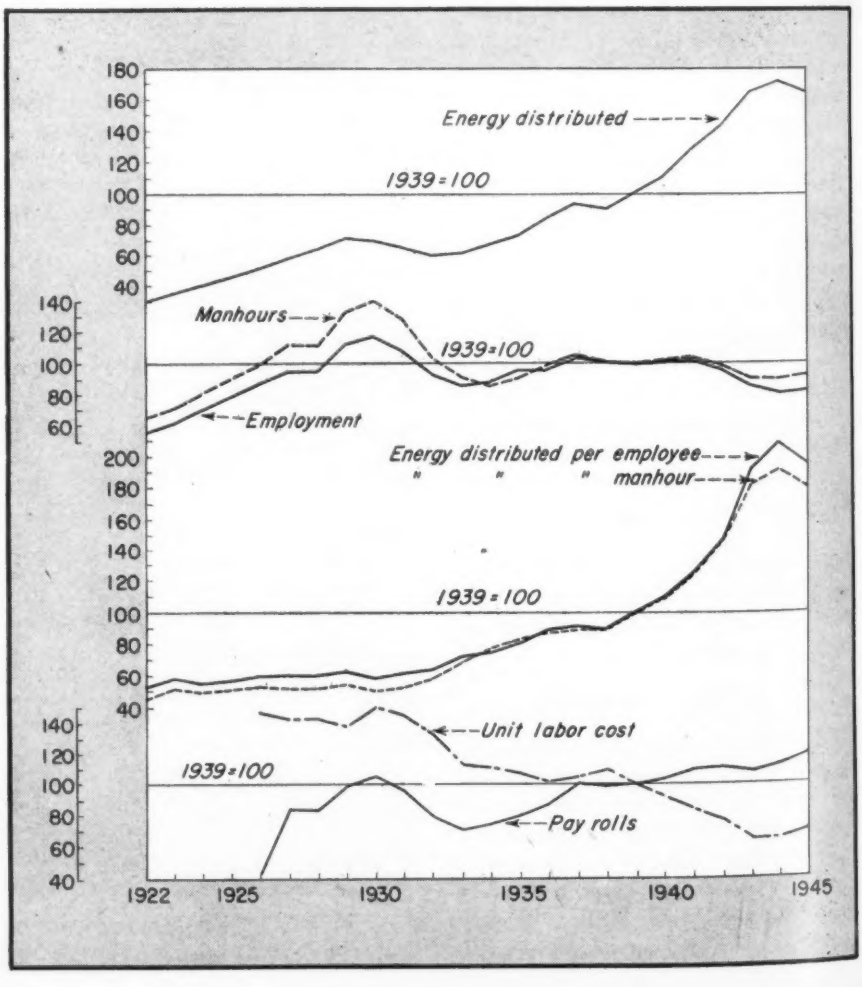
The cabinet standards are calibrated with master standards approved by the State Public Utility Commission. These master standards are placed in the same position as the meter under test.

This testing device has been in constant use in the meter shop of the Philadelphia Electric Co. for over 18 months. It has proved highly satisfactory, not only in increasing production, but in relieving the tester from much monotonous routine.

Productivity and Cost of Electric Utility Labor

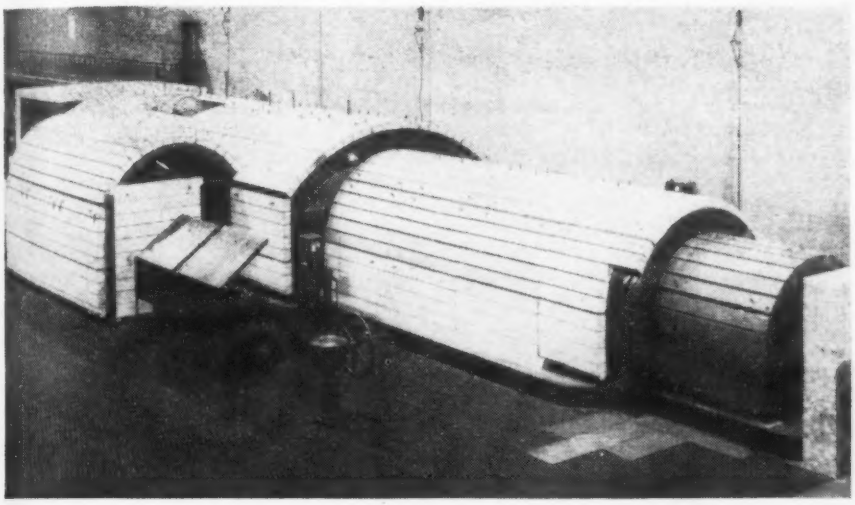
THESE CURVES were drawn from data released by the Bureau of Labor Statistics, U. S. Department of Labor. They are for employment in power companies only.

The indexes of output per employee and per man-hour show a moderate, fairly steady increase from the beginning of the period through 1932 or 1933 and a more rapid increase to 1939 or 1940. The increased rise of productivity during the thirties accompanied a notable increase in energy sold per customer in those years. During the recent war period, average sales per customer continued to increase, but productivity rose even more rapidly. In fact, energy distributed per man-hour worked nearly doubled between 1939 and 1944. This unusually rapid rise is attributable to the steadier use of equipment near peak capacity, aided by power-pooling agreements, and to reductions in personnel by inductions and enlistments in the armed forces. There is no clear evidence that deferment of maintenance work was sufficient to contribute significantly to the increased productivity. The decline in output per man-hour between 1944 and 1945 reflects the drop in sales to large power users.



Equipment Vulnerability To War Damage Measured

Analysis of experience during and after "blitz" affords indexes of relative proneness to damage by high explosive bombs and incendiaries



CONCRETE BLOCKS on angle-iron framework were as effective as brick enclosures in protecting power plant units against bomb damage

G. V. HARRAP

Deputy City Electrical Engineer
City of Norwich, England

ONE of the important lessons of the blitz was that some electrical equipment is more likely to be damaged than other types of apparatus. As early as 1941, British engineers conceived the idea of assessing vulnerability of certain types of apparatus by a "damage proneness number" to express the probability of maintenance required after bombing attack and a rough approximation to the extent of damage liable to be incurred. Tables I and II express relative "damageability" from direct attack and Tables III and IV what may be expected as aftermath delayed effects.

These ratios have been found useful in determining amount of loss likely to be suffered in a given plant and making preparations beforehand for repairs.

These figures can be modified somewhat by a "danger coefficient" taking account of the proximity to the center of damage. Such a factor was useful during actual restoration of service but is of little use in assessing salvage value or long-term planning of repairs.

Delayed effects from blast and fire, not easy to locate at the time of damage, have a way of showing up in the statistical record over a period of time. To account for this a "fault frequency" record has been kept showing faults per square mile of system per year. Tables III and IV. For normal municipal systems in Britain, fault frequency averages about 1 for low-voltage distribution systems and one-third for high-tension transmission, both expressed in faults per square mile per year. On the worst bombed sections, during the Battle of Britain, this fault frequency rose to 540, requiring a high degree of organization to deal with repairs.

In two years after the most severe enemy action the fault frequency averaged about 2.7 for low-voltage systems and 1.4 for transmission facilities. Tables indicate the distribution of faults from delayed effects. It is interesting to note that the repair squads were able, with the forestudy of probable occurrence, to restore service within half an hour to 45 percent of the interruptions and within an hour to 78 percent.

TABLE I

DAMAGE PRONENESS NUMBER FOR ELECTRICAL EQUIPMENT

Equipment	Cause of Damage: H. E. Bomb	Cause of Damage: Incendiary Bomb
Metal-clad Switchgear (Castings)	40– 60	30– 60
Metal-clad Switchgear (Fabricated)	20– 40	30– 60
Sheet Steel Cubicle Switchgear	80–100	20– 40
Outdoor Switchgear	20– 40	15– 30
Instruments	80–100	80–100
Modern Transformers	60– 80	40– 60
Old Corrugated Tank Transformers	80–100	80–100
Underground Cables	20– 40	80–100
Overhead Lines (bare conductors)	20– 30	20– 30
Overhead Lines (covered conductors)	20– 30	80–100
Motors (A.C.)	20– 30	70– 90
Motors (D.C.)	60– 80	80–100

TABLE II

DAMAGE PRONENESS NUMBER FOR FACTORY EQUIPMENT

Equipment	Damage Proneness Number
Boilers	30
Buildings (Lime Mortar)	80
Buildings (Cement Mortar)	30
Conveyors	100
Electrical Equipment	70
Motor Vehicles	50
Packaging Equipment	75
Processing Plant	50
Refrigeration Plant	60
Service Piping and Wiring	100
Miscellaneous	50

TABLE III

CAUSES OF LOW VOLTAGE FAULTS ARISING FROM DELAYED EFFECTS OF WAR DAMAGE

Cause of Fault	Number of Faults
Demolition of Property	41
Consumers' Installations	20
Cables and Joints	15
Undertaking's Staff	8
Fire on Consumer's Premises	3
Accidents	3
Consumers' Staff	1
Other Public Utility Staff	1
System Disturbances	1

TABLE IV

CAUSES OF HIGH VOLTAGE FAULTS ARISING FROM DELAYED EFFECTS OF WAR DAMAGE

Cause of Fault	Number of Faults
Cables	13
Switchgear	5
Consumers' Installations	5
Transformers	4
Joints	4
Undertaking's Staff	3
Other Public Utility's Staff	2
System Disturbance	1

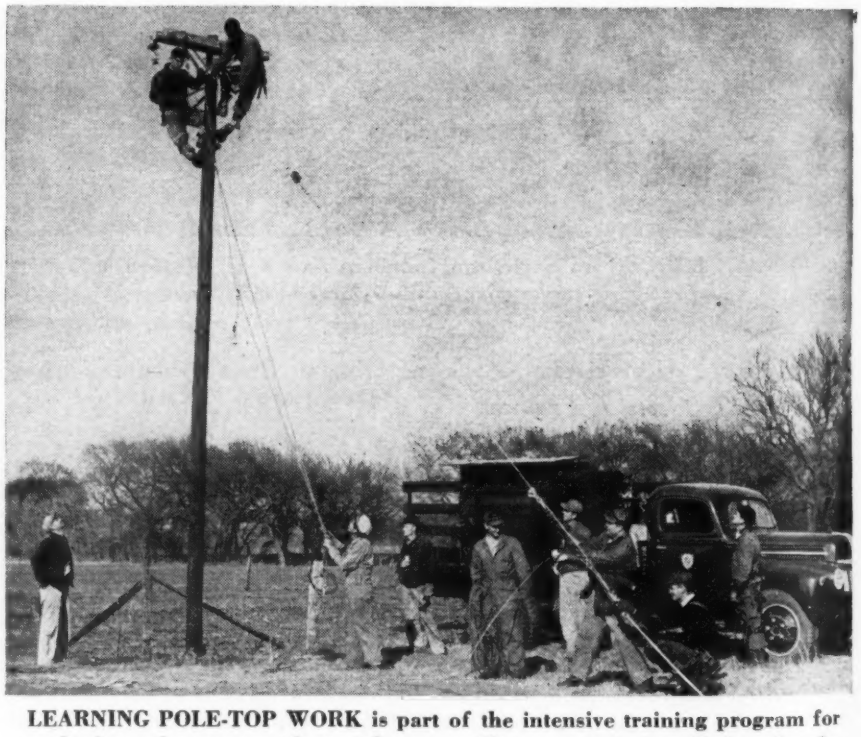
LINEMAN TRAINING COURSE
Combines Class and Practice

R. F. DANNER, *General Superintendent, Oklahoma Gas & Electric Co., Oklahoma City, Okla.*

Forty-one men added to the line construction forces—Selected from 59 who started—Alternating periods for explanation with equal time for practice in four-week intensive training period—Rating of individual progress is important in orientation

IMPORTANT ADVANTAGES compared to merely hiring and assigning new men to various line crews are realized by a training-on-the-job course for apprentice linemen, with a combination of class-room study and field practice. It assures an opportunity to cover essential points in the training while at the same time affording an opportunity to select the more promising men from among those taking the course. Following the individual's progress is important also in the months of actual field experience after the basic training period.

The course developed by Oklahoma Gas & Electric Co. is planned especially for war veterans but is open also to non-veteran applicants who fit the requirements. Approved by the Veterans' Bureau, it offers opportunity for certification as trainees under the veteran benefit policy. This must, however, follow selection after aptitude, attitude and willingness to work have been observed and considered satisfactory.



LEARNING POLE-TOP WORK is part of the intensive training program for each class of not more than eight men. Here a guy is installed under the watchful eye of the instructor

Planned-Training Advantages

A planned course gives the veteran a chance to find out what the new job is like in short order and at the same time to derive a thorough grounding in the job fundamentals. Apprenticeship is started on a solid basis rather than through hit-or-miss trial in a line crew. It is an opportunity to swing into a civilian career in a rugged outdoor job where alertness, mechanical skill and physical stamina count heavily. But its requirements are such that a few weeks in practice may lead to a change in the original desire.

The benefits for the company are both from the standpoint of selection of especially adapted men and also in starting them on the right track for some of the most exacting jobs in the electrical industry. A few weeks at a non-productive training center offers an opportunity to observe the individual applicants in action and to help them form correct work habits before they are assigned to line crews.

An incidental advantage, both for the employee and the company, is in prompt selections of successful candidates. At this time, the preliminary training of seven groups of approximately eight men each has been completed. Of 59 men starting on the apprentice training, 41 are now actively working on line construction projects. The 18 men who started, but are not now working, were dropped as unsuitable for further training, or dropped of their own accord because of lack of interest in this type of work.

TABLE I—Class Schedule for Apprentice Linemen

Day	8–10 a.m.	10–12 Noon	1–3 p.m.	3–5 p.m.
1	Orientation; Introductions, plan of course	Visit: Storeroom, Local Engr. & Line Depts., Garage-Meter Dept., Service Desk, Old Plant Bldg., Broadway Sub.-Dispatchers.	Review Company Policies	Issue Tools: climbers, hand-tools, etc., sound-slide — Hand Tools.
2	Safety Rules — Issue books and discussion. Sound-slide — Lifting.	Build climbing setup, dig holes, cut off and shave poles, etc.	Ropes: Care of knots; bowline, square, sheep shank, timber hitch, sheet bend, cats paw. Whip end of rope.	Build 20-ft. poles Climb 20–30 min.
3	Rope blocks-splices; eye-splice, long-splice, crown knot.	Build Setup — 25-ft. poles. Pike poles, etc. Climb	Rope blocks — Loading Blue prints	Climb — 20–25-ft. poles
4	Poles: Life, uses, etc. anchors, S4P arms	Climbing. Set 30-ft. poles	E. E.— Instruments	Climbing Same as a.m.
5	Safety: Pole hazards, bracing poles	Climbing 20–25-ft. Install arms, frame poles.	E. E.— 1 Resistance	Climbing 25-ft. Same as a.m.
6	Crossarms-D4P, etc.	Climb — S6P Arms	E. E.— 2 Ohm's Law	Same as a.m.
7	Pins and Insulators (steel and wood pins); ridge pins, neutral brackets, 1 sp. racks	Frame and install double-arms	E. E.— 3	No. 6 WP wire ties — Fig. 8, S4P, D4P Arms
8	Rural Line Materials	Wire ties — No. 6 WP	E. E.— 3 Series and Parallel Resistance	Wire ties and splices No. 6 WP
9	Rural Line Materials	Install D6 pin and deadends — 2 No. 6 WP	E. E.— 4 Magnetism	Install double arms. Same as a.m.
10	Line Conductors; Cu, Al, etc.	Climb 25-ft.–30-ft. poles. Arms and wire	E. E.— 5 Electro-Magnetism	Climb 30-ft. poles. Arms and wire
11	Guys and Anchors	Replace short poles with 30-ft. Rural Construction — Hardware	E. E.— 5 Electro-Magnetism	Same as a.m.
12	Guys, Pole and Transformer Grounds	Practice rural tie No. 6 copper — 30-ft. poles	E. E.— 6 Induced E. M. F.	Practice rural ties, etc.
13	Protective Grounds, Ground Sticks, etc.	Grounding lines for safety.	E. E.— 6 Induced E. M. F.	Aluminum armor rodding and splices
14	Transformers and Devices — Quiz	Aluminum — Rural Const.	E. E.— 7 Alternating Current	Same as a.m.
15	Rubber Goods	Aluminum	E. E.— 8 Power	Aluminum
16	Prone Pressure	Aluminum	E. E.— 9 A. C. With Inductance	Same as a.m.
17	Transformers; Clearances, H'ways, other systems	Aluminum	E. E.— 9 A. C. With Inductance	Same as a.m.
18	Quiz: 3-phase, Trans. Conn.	Steel wire lines and ties	E. E.— 10 Transformers	Same as a.m.
19	General Review	Transformer installations	E. E.— 11 Transformers	Same as a.m.

There are three periods in the schedule of training from application to apprentice lineman, requiring one year for completion.

Plan of Course

In the first period, the new men are employed in one of the divisions at the prevailing labor rate. During from one to three months they dig pole holes and do other general labor type work, learning the application of various items of equipment used on overhead lines. Employees are selected from this initial experience for certification as trainees and are then sent to the central training school.

Not more than eight men are included in each class group for the one month at the school. Alternate sessions in class-room and in field practice, with four 2-hr. periods each day, are fundamental in the training center plan of operation. A 2-hr. session of explanation and discussion is followed by a like period in the practice yard. Another 2-hr. class period after lunch is followed by further practice. Breaking the day into these alternate sessions between concentration and outdoor activity helps to sustain interest and insures against "going stale" in addition to the value of putting into practice the classroom knowledge acquired in the study periods.

Final Training Phase

After four weeks in the center, members of the class put in two weeks on a field construction job and then return individually to their original divisions to work with regular line crews during the final period of the schedule. Supervised training is continued on the items already covered, with the addition of three-phase transformer connections, sagging conduc-

CLASS IN LINE MATERIALS follows the instructor as he explains principal items used in line construction. In other sessions the class learns the principles of electricity. Class-room sessions are followed by field practice

tors, installation of meters and handling materials.

Individual rating reports are made by the instructors during the class and practice period of training. Interest, attitude, work habits, attention, ability to understand and follow instructions, and ability to work with others are rated as above average, average or unsatisfactory. Physical condition, muscular coordination, mechanical aptitude, climbing ability, rate of improvement and accuracy are similarly noted for the field work.

During the separate material and electric class periods, the trainee is rated by the instructors in interest, ability to grasp fundamentals and application and reasoning ability. Recommendations are made from these ratings to continue training, transfer or to drop the individual.

A progress report follows the employee to his line crew job. Division superintendents or the man's immediate foreman rate the question sheets which are phrased so that check marks may be used to describe the employee accurately.

TABLE II—Employee Progress Report
For On-The-Job Training Course For Linemen

Place a check mark (√) before the phrase which most accurately describes the employee. Use a plus mark (+) or a minus (−) if you think the employee deserves a higher or lower rating.

QUALITY OF WORK ( ) Few errors normally. Work of acceptable quality.	( ) Work is inaccurate and below standard.	( ) Work is accurate and well done. High quality.
APPLICATION TO WORK ( ) Generally applies self to work.	( ) Not industrious. Needs urging.	( ) Always applies self. Very industrious.
ADAPTABILITY ( ) Reasonably satisfactory on unfamiliar jobs.	( ) Has difficulty when shifted to unfamiliar jobs.	( ) Readily adjusts self to unfamiliar jobs.
QUANTITY OF WORK ( ) Generally has satisfactory output.	( ) Small output.	( ) Large output.
INITIATIVE ( ) Reasonably satisfactory in acting voluntarily on unusual problems.	( ) Is not a self-starter. Relies on others.	( ) Superior at going ahead when unusual problems arise.
COOPERATION ( ) Gets along well in team work with most people.	( ) Does not get along well with others. Poor team worker.	( ) Gets along splendidly in team work with others.
DEPENDABILITY ( ) Reliable in performance of most duties.	( ) Cannot be relied upon. Needs much follow-up.	( ) Reliable in performance of all duties.
ABILITY TO LEARN ( ) Normal ability to grasp new ideas.	( ) Grasps new ideas slowly.	( ) Grasps new ideas quickly.
SAFETY ( ) Generally considerate of safety, of self and others.	( ) Careless of safety, of self and others.	( ) Very considerate of safety of self and others.

Remarks: (Give your opinion on any outstanding qualities or defects this man may have.).....

.....

.....

.....

.....

.....

Human Interest

Experience with the training course has demonstrated a human interest factor that is worthy of careful consideration. Practically all of the veteran-trainees, after a long time in the Armed Services, have been thoroughly indoctrinated in following instructions implicitly and know from experience the importance of this characteristic. They are alert and receptive to any suggestions. This inspires confidence in them on the part of experienced associates and supervisors.

This attitude puts considerable responsibility on management to provide competent and efficient instructors. The men can absorb an accelerated series of instructions and they can benefit largely from an opportunity for orientation and training at a faster pace than possible entirely on the job.

Under this program the required time is reduced and the company can in turn expedite execution of its post-war construction and repair program.

It was recognized from the start that especially qualified and experienced supervisory men would need to be definitely interested in this new program. Consequently, the development has been in the hands of John W. Shawver, training supervisor, assisted by Frank Koontz, operating supervisor. The line materials class is taught by H. E. Carpenter who has long been a member of the engineering department, and safety and first aid are taught by J. R. Steele, the company superintendent of safety.

THE CASE FOR

Utility Merchandising

P. C. SPOWART
Sales Manager
Seattle City Light

TODAY Seattle has a national reputation of having more electric ranges and water heaters in use than any other city in the United States. This, and our average annual consumption of 3,600 kw.-hr. per residential customer, we submit, is because of the city's aggressive load-building policies over the past 35 years. City Light has won national recognition for the merchandising job it has done. Tens of thousands of satisfied customers have purchased appliances from the city during this period. We have had the overwhelming support and approval of the public for the way we have conducted our business, and I am sure that many thousands will insist that we continue past policies.

We are sincere in our belief that we should continue to sell major load-building appliances, including automatic electric hot water-heating equipment and electric-cooking equipment for commercial use. We also feel that a utility should promote and sell new major appliances that have not yet been accepted by the public. The city will promote and sell this equipment to replace coal, wood, oil and gas installations. The Department will not seek the electric range replacement market. Emphasis will be placed on electric water heating, for this is a field of load building that has the greatest potential value to a utility.

Stress on Utilization

Our sales personnel will be salaried employees under civil service. They will stress the utilization of electricity for every known use in the home and business. Their efforts and objectives will be directly beneficial to the entire industry. To stop the Department from merchandising certain load-building appliances would deprive the city of one of its most useful functions, and would not be compatible with the public interest.

There have been many articles written stating the utility's point of view on the electric range. The only excuse for promoting electric cookery is to counter the promotion of other fuel in the home which may be used not only for cooking but also for water heating. We must not forget that gas is still a formidable competitor of electricity. It is an accepted fact that the surest way to lose business is to quit promoting it.

This article is the essential substance of a letter addressed to the chairman of a dealers' committee in response to a recent suggestion that the utility retire from merchandising.

In the past when dealer sales lagged, the Department would subsidize wiring and plumbing installations. This would immediately increase sales for everybody. In other words, we put the profits made from merchandising back in the business where the public and the dealers became the beneficiaries. Most dealers have a keen sense of appreciation of what we have done in the past and are anxious for us to continue this program in the future. Subsidizing wiring and plumbing installations creates an ease of selling and expedites the installation. For the plumber and wireman it creates a greater volume of business and eliminates their collection problems and other costs.

I have recently talked to utility executives from coast to coast on the subject of merchandising. All agree that if you want to build residential load the surest and fastest way is to sell major appliances through your own organization as well as through the dealer. I have never found a utility that went out of the merchandising business because it did not build load. I have found several that have gone out of merchandising because of outside pressure.

Utility Promotion Profits Dealer

Our program includes free labor service on electric ranges and water heaters, including their electrical connection. This service saves the electric users thousands of dollars a year. The city has been generous in its promotion program. We give freely of our money, time, talents, facilities. A large share of our $50,000 advertising budget is spent to promote business for the dealer. The Light Department has already spent large sums promoting the sale and acceptance of appliances. More will be spent in the future. No organization could do more for the dealers. Millions of dollars will be spent for new electrical equipment in Seattle because of low electric rates. Millions more will be spent on replacement of worn out major appliances. It would be folly to drop our present program when we know that our past activities have made Seattle outstanding from an electrical point of view. If we discontinued our promotion of appliances and our service department, the private dealers would suffer as much as any one.

We are now entering a period of inflation. The present cost of doing business has increased very substantially over pre-war days. Future power developments may cost double our former horsepower cost. A utility has a choice of meeting this rising cost by increasing rates or by increasing consumption so that additional revenue will offset present and future inflation. City Light has chosen the latter.

This in brief is the case for utility merchandising.

EDITORIALS

S. B. WILLIAMS, *Editor*

Labor's Bulwark—The Courts

EMPLOYEES of the Duquesne Light Co. and those of Pittsburgh's organized labor who supported them have won their fight against an injunction prohibiting them from any action which would imperil public health and safety through a cessation of electric service.

It is not hard to understand the sentiments of a strongly organized mass of industrial workers in striking swiftly against a use of injunctions in labor disputes.

It is difficult to believe that organized labor counted the full cost of its action in slugging the city and the court to their knees.

What are labor's precious rights but laws? Who enforces laws but the courts? What leads labor to believe that a court once coerced can not be coerced again? Why does labor think, if it thought this far, that the public, which vastly outweighs organized labor in votes and strength, once aroused, can not coerce the same courts into sidestepping the same laws which are labor's only title to its rights?

The city's action in Pittsburgh was a drastic thing. No one knows better than Pittsburgh labor that it was taken reluctantly, by officials whose pro-labor records are as good as those of Pittsburgh labor leaders.

What leads organized labor to believe that the right of utility workers to strike will remain above the right of metropolitan citizens to water for drinking, fire fighting, sanitary purposes? What safeguards the right of the relatively few utility workers in contravention of the right of babies to safe milk, surgical patients to light in the operating room, the metropolitan public to adequate stocks of refrigerated food?

Just as rates and conditions of service are regulable, so, we believe, is continuity of service coming closer and closer to the stage where it too will be regulable. The right to strike against life or death services can be abridged as was the right to charge for such services what the traffic would bear. If this be deemed an anti-labor doctrine, is it not also a pro-public doctrine?

Most utility workers and managements settle their labor problems well short of strike action. But when some do not, another measure is placed in the balance which weighs all utility labor.

One of the reasons the balance has not yet tipped is because no one has yet figured out how to do full justice, how to protect the public without hurting labor. When the balance tips, if it be tipped, the question will automatically become less complicated. Then it will be merely how to protect the public.

When the resulting, vengeful laws are enacted, labor's bulwark will be the agency it assaulted recently in Pittsburgh—the courts.

Electronics an Integral Part of Electrical Engineering

ELECTRONICS is emerging as a major subject for attention of all electrical engineers but many still think of electronics as another name for radio. Three universities and the Chicago local sections of A.I.E.E. and I.R.E. are, however, showing the way toward a better appreciation of this newer branch of engineering. The national conference just held in Chicago provides a forum on electronic research, development and application without starting a new society or institute for membership. The committee is to be congratulated on the aims as well as the interest evidenced by a registration of 2,500 and more than 60 papers.

Radio still ranks first in the volume use of vacuum tubes but industrial applications are accorded opportunity for a number of developments to be discussed at the conference. The primary aim of engineering in electronics now is one of industrial application. Specialists will design the tubes, just as others design oil switches, transformers and motors. Nevertheless utility, industrial, communication and radio engineers need to study the principles of electronic circuits if they are to develop the full possibilities in their particular fields. To segregate knowledge of industrial electronics by setting up a new organization would retard rather than advance the progress toward a more general understanding.

An annual national conference for electronics is justified by the magnitude of the field for development. It should be continued as a cooperative project and officially recognized by the national societies having interests related to electrical engineering. Electronics can be a common meeting ground for these technical groups. It should not be made the basis of still another organization.

George Westinghouse Centennial

ONE hundred years ago the beginning of this week George Westinghouse was born. Though essentially an organizer and an engineer there were issued to him between three and four hundred patents. Though not an electrical engineer so much as he was a mechanical engineer, his greatest impact upon civilization came from his contributions to electrical progress.

Of these, the most important was his battle for alternating current to extend the distribution of electricity

beyond the small areas of economic operation with direct current. To speculate on what might have happened to the electrical industry and to the economy of this country and the world had Westinghouse not envisioned the advantages of alternating current and fought so successfully for it would be fruitless, since its inherent economy was bound ultimately to bring it into the lead. What is interesting is that one whose background was mechanical should, at a time when the whole art of electrical distribution was in its infancy, recognize in a crude transformer invented by a Frenchman and an Englishman such possibilities and have the courage in the face of great opposition to put all his energy and limited resources behind it. But that was George Westinghouse. It was not the first time he had staked everything on what he was sure was right. He had done it before in railroad safety methods and was to do it again in steam power generation.

As so often happens with a man of great courage and conviction he attracted other men of ability and so inspired them that tasks were undertaken and accomplished against seemingly impossible odds. Between the time he became interested in the Gaulard-Gibbs transformer and the opening of the Columbian Exposition in 1893, where he displayed in operation a complete alternating current system, was a matter of less than eight years and in that short space of time every basic element of the system from the meter down through conversion and primary utilization equipment had to be developed.

And so on this hundredth anniversary of his birth we pay honor to the memory of one who through his great vision, courage and genius for organization contributed so greatly to electrical progress.

Mobile Communication Ready For More Responsibility

MANY power companies have installed extensive mobile radio systems to provide two-way emergency communication, and to them the recent Federal Communications Commission order reclassifying the service will be welcome news. To others, the new regulations will permit examination of the question of radiotelephony on a broader base.

It was difficult to interpret just what constituted an emergency under the regulations of the past. The Commission now recognizes that a wider scope of service permitting full operational use may in many cases prevent the occurrence of an emergency and will assist in rendering a better service to the public. Under the new rules, instructions may be issued relative to the operation and maintenance of generation, transmission or distribution facilities.

The effect is to release mobile radio for its primary function—to expedite calls to men who by the nature of their work can not have a wired telephone at hand while they are performing their regular duties.

Recent developments have contributed also to the practical possibilities of radio as a reliable working tool for utility service. Selective calling devices, FM systems and the use of higher frequencies have passed the experimental stage. Probably a longer life basis can be used in the cost estimates for future installations.

Mobile communication would seem to be ready for an up-to-date appraisal. It may now assume a larger share of responsibility in service.

In Mitigation of Sectionalism

RECURRENTLY there is heard complaint from one or another of northern and eastern states of money being drained out of those states via federal taxes and spent with lavish hand for developments and improvements in far parts of the country—irrigation is provided at a cost to beneficiaries that does not include interest on the money invested—navigation improvements are made to open up or enlarge routes of commerce that divert trade and industry from established places—flood control benefits local populations at national expense—tax-free power projects lure industry to new locations.

In a democratic country as large as the United States, this kind of sectionalism is bound to be a strong element in national politics. There never has been, probably never will be, a session of the Congress in which sectionalism did not or will not appear. It has its uses. Often it is the ultimate resolution of difficulties in the way of getting something done, the old "log rolling" technique. Often also it is a rasper of tempers, a breeder of suspicion, a questioner of motives, that only aggravates legislative difficulties.

Therefore when opportunity arises to mitigate that aggravation, it seems only sensible that it be grasped. Such opportunity appears in the proposal of the Savannah River Electric Co., an affiliate of Georgia Power Co., to build the Clark Hill project which has been authorized by the Congress to be constructed by the Corps of Engineers at federal cost. As is pointed out to the people of the locality in newspaper advertising by the electric company, its construction of the project will realize all of the promised benefits of navigation, flood control and recreation and the development will be subject to all federal, state and local taxes. Thus, instead of being a drain on tax revenue from other parts of the country, the project will be a producer of tax revenue in the section where its benefits reside.

No one can quarrel with the proposition that for the good of the whole nation the richer regions should help to pay for improvements in those less well supplied with money. But when a region not so rich shows itself willing and able to carry part of the burden of cost for its improvement common sense would say that it be allowed to do so, if for no other reason than that the sharpness of sectionalistic arguments will thereby be somewhat smoothed.

WASHINGTON COMMENT

By R. N. LARKIN

Utility Labor Legislation

REGARDLESS of whether the Democratic Party retains control of Congress, or whether it loses control, or whether control is divided between both major parties, the 80th Congress will face the problem of how to realign the nation's labor law.

When the problem is voted upon, if it be voted upon, the legislation at issue can hardly escape having at least an indirect bearing upon the labor problems of electric utilities. Judging from some of the ideas threshed out by Congress during the last session, labor legislation arising in the 80th Congress will have a direct bearing on electric utility labor relations. Several plans directly affecting public utility labor disputes were voted upon by the 79th Congress, after presentation by more or less substantial and influential members. The public utility labor picture over the months which have intervened since Congress last fought the battle of national labor law has not been one to indicate that there is no necessity for legislation specifically protecting the public in labor disputes affecting utility service.

Study Is Needed

These considerations should indicate, then, that the ground rules of electric utility labor relations may in six or twelve months be considerably different than they now are. Naturally, utility management will have a vital interest in whatever changes are made. Obviously, the time for utility management to be studying what it would like to see in any such law is now, well in advance of the day when testimony will be taken by Congressional committees on such imposing suggestions as abolition of the right of utility workers to strike, compulsory arbitration, mandatory cooling-off periods, government seizure and the like.

Whatever decisions utility management reaches in its preparation for the day when national legislators will be writing new rules for the conduct of local enterprises, they must be taken in full recognition of the long-term possibilities as well as the short-term results. Utility management, being charged not only with the duty of earning a return for its investors, but also with the duty of rendering an indispensable public service, must take double precautions to insure that its advocacy of a device which would have an immediately beneficial effect does not saddle it with a device which could, later, render it less able to earn and serve. In addition to having a positive program to present, utility management must have a strong case ready against those concepts it feels would be its undoing. After all, when Congress begins to write labor legislation of direct or indirect effect upon public utilities, it will be undertaking certain very real functions of management, but it will not be assuming the duties and responsibilities which its action will impose upon management. Whether rightly or wrongly, those will be for management to shoulder.

After many years, Congress is returning to a state in which it will listen more or less seriously to the views of the electric power industry on matters confronting it. The first year's operations of the National Association of Electric Companies demonstrated this, even though they did not result in any sweeping, conclusive victories for private ownership as against public ownership.

It seems likely that the next Congress will be even more disposed to consider the industry's views. N.A.E.C., with a year's experience, a year's contacts, a year's good record, will be in an improved position to help the industry present its views. The industry, fortunately, is not in anything like so impossible a position as it was in the matter of domestic atom control, where concrete knowledge was not available because of government refusal to release it. In deciding its labor course, the industry can seek facts and advice in a free market.

In reaching its decisions for or against such proposals as abolition of the right to strike, compulsory arbitration, government seizure, and such multitudinous devices as mandatory cooling-off periods, local and federal mediation, fact-finding and all the rest, the industry would be well advised to consider the political aspect of the courses it decides to support, or oppose. Without arguing that something which is right for the industry should be discarded merely because of unpleasant political aspects, it can be asserted that one of the best ways to sell Congress an industry program is to remove from it as much political risk as can be removed.

It is obvious that curtailment or abolition of the right to strike is politically dangerous. Perhaps it is the only answer; perhaps no answer at all. The point is that if the industry has any hope of selling a labor program to Congress, one of the factors in deciding for or against a recommendation to abolish utility strikes should be the political consequences of any such move.

A Program Is Needed

By advancing a program which makes sense, which can be demonstrated to be logical and to give some promise of doing the necessary job, and which even yet is considerate of the facts of political life, the industry can do more than protect itself against rebounds in the form of poorly conceived labor law. It can also enhance the value of future witnesses it sends before Congress on other matters—taxation, public ownership, regulation, and the rest.

The decisions which will have to be made by the industry's management if it is to minimize the damages which Congres could do in enacting popular but unwise legislation will be difficult to reach. They will require immense work and trouble. To the extent that they are wise, and well presented, utility management will have done its part in staving off burdens that might otherwise be imposed by people who have no responsibility for—or intention of—carrying them.

NEWS OF THE WEEK

Duquesne Plants Operating as Strike Goes on Unabated

President McCance Rejects Union Offer Calling It Re-Shuffle of Previous Demands—Mueller Had "Must" List of 11 Points —Substation Employees Bolt Independent Union for A.F.L.

THE Duquesne Light Co. closed its fourteenth strike-bound day by carrying a 241,000-kw. evening peak this week, just 50 percent of normal demand for that hour. The peak, occurring between 7 and 8 p.m., October 7, was the highest on the system since the strike began at 9:30 a.m., September 24, company officials said.

While the company continued to maintain load as it had since the start of the strike, negotiations continued as fruitlessly as they have for several months, with the union president, George Mueller, making a second "new offer" which the company described merely a "re-shuffle" of previous demands. President Pressly McCance of the Duquesne Light Co. rejected the offer early this week, and called upon the union to arbitrate the dispute, as the company had urged on September 4.

Company officials said Mueller's offer was unchanged from that he made a week previous except that he agreed to arbitrate, after 30 additional days as negotiation, any issues other than the eleven which he demanded be settled immediately as a forerunner of a return to work.

Meanwhile, Mueller's independent union, long a target of A.F.L. and C.I.O. organizational forays, seemed to be heading toward a breakup as nearly 1,000 workers joined District 50 of the United Mine Workers, A.F.L., which petitioned the National Labor Relations Board for certification as their bargaining agent.

Just before the strike started, District 50 claimed somewhat less than 300 employees of Duquesne's Colfax plant. Last week, an additional 700 substation employees split off from the independent union and petitioned the State Labor Relations Board for an independent union. Since they were members of a bargaining unit which originally had been established by the National Labor Relations Board, the petition was changed to seek NLRB certification of a new bargaining agent, District 50. These employees were members of a Duquesne bargaining unit known as Duquesne Light Hourly Employees, Unit No. 1, which is the only one of nine existing bargaining units to have been established originally by NLRB rather than by the State Board.

Mueller's offer demanded immediate settlement of eleven points in dispute. Upon settlement of these, the union membership, he said, would be called upon to end the strike. If any of the remaining 24 issues were unsolved after 30 additional days of negotiation, they would be subject to arbitration.

The eleven issues which he demanded be settled immediately were:

1. Continued company operation of its construction department.
2. A union shop.
3. Enactment of nine uniform contracts rather than a single master contract.
4. 20 percent wage increase.
5. Four additional paid holidays yearly.
6. Three weeks' vacation after 15 years' service.
7. Restoration of the "1933" pension plan.
8. A separation wage plan unchanged from the original demand.
9. Expense money for meals reduced from $1.50 to $1.25.
10. Fifteen minutes' "bridge time" paid to employees at Brunot's Island plants.
11. Overtime and holiday pay demands combined to yield time and one-half for the sixth day and double time for the seventh day and holidays.

McCance, in rejecting the offer, called upon the union to accept arbitration now and cut the losses being inflicted upon the community.

The company's effective operation of its system continued without additional employees in the plants, a spokesman said, although a few employees have

FIRST WINNER—President E. J. Doyle, left, Commonwealth Edison Co., Chicago, presents to John Berry, a line foreman, the first Edward J. Doyle award recently created to give recognition to employees for the saving of human life. Berry, using methods learned in company safety classes, revived a young woman who nearly drowned in the Fox River. Roy A. Dingman, vice-president in charge of industrial relations, is at the right

returned to work in the offices. No trouble has been experienced in feeding the force of supervisors which had been operating the plants for 15 days as this was written. It was asserted that this force could continue indefinitely operations at the levels of the first two weeks.

Coal was being received regularly at all four generating stations early this week, an improvement from the position of a week previous when no coal was being received at the Phillips station because of the action of pickets.

Last Monday, all large and many small stores opened again in Pittsburgh after having been closed for 13 days. Company officials said they did so without being granted any additional energy, and that the reopening had only a mild effect upon system load. From 25 to 30 diesel-powered generators were set up in downtown stores, with one store installing three 250-kw. units.

Over last weekend, when load is normally down, Duquesne Light urged housewives to do what washing and ironing they could before the new week started and the load rose again to normal weekday levels. Although load figures showed little effect of the move, many housewives took advantage of it, company officials said.

Downtown Pittsburgh, which takes steam heat service from a Duquesne affiliate, continued without heat this week after service was cut off October 3. The city's hotel strike, not a sympathy walkout, continued in effect early this week, as did the transit strike, caused when A.F.L. operators refused to cross Duquesne union picket lines.

Following are Duquesne's preliminary hourly load figures in thousands of kilowatts for October 2, 3, 4, 5, 6, and 7:

Time	Wed.	Thurs.	Fri.	Sat.	Sun.	Mon.
7	117	119	124	112	100	126
8	139	149	154	115	99	151
9	167	171	173	135	115	177
10	180	178	180	149	125	198
11	187	184	190	155	128	203
noon	177	168	170	148	120	189
1	174	173	172	147	125	189
2	178	185	179	143	129	191
3	172	179	174	142	124	188
4	164	165	172		118	187
5	161	164	171			172
6	169	168	187			198
7	217	212	217			234
8	214	214	210			232
9	211	202	197			

•

3,067 Customers Added

Despite shortages of materials and labor, the Eastern Shore Public Service Co. of Maryland has added 3,067 customers during the last twelve months. A shortage of meters has led the company to offer service to new customers on an estimated billing basis until meters again become available.

Badger Co-op Balked in Move to Buy Wisconsin Hydro Co.

P.S.C. in 2-to-1 Decision Rules That Purchase Price Is too High — Cooperative now Owns no Electrical Properties —$3,649,200 of REA Funds Would Have Financed Transaction

BADGER Electric Cooperative of Amery, Wis., has been denied permission by the Wisconsin Public Service Commission to purchase and operate the properties of the Wisconsin Hydro Electric Co. in northwestern Wisconsin.

In its 2-to-1 decision the commission followed the recommendation of its examiner, Calmer Browy, who recommended in July (ELECTRICAL WORLD, July 13, Page 5) that the co-op's petition be denied.

The majority of the commission ruled that the reasonable value of the Hydro properties is $3,000,000 and that the proposed issue by Badger, to finance the purchase, of $3,649,200 of mortgage notes does not bear a reasonable ratio to the value of the properties and to other securities as required by law.

Badger Formed by 8 Co-ops

The Badger co-op neither owns nor operates any electrical property and is actually a holding company formed by eight co-ops: Barron County Electric Cooperative, Buffalo Electric Cooperative, Chippewa Valley Electric Cooperative, Dunn County Electric Cooperative, Pierce-Pepin Electric Cooperative, Polk-Burnett Electric Cooperative, St. Croix County Electric Cooperative, and Dairyland Power Cooperative.

Badger was formed with full public service status to serve members and non-members alike and is under the jurisdiction of the commission.

The co-op, which topped a bid of $3,100,000 by Northern States Power Co. for the properties, bid $3,449,000 for the properties, which must be sold by the Manufacturers' Trust Co. of New York because of the Public Utility Holding Company Act. Badger proposed to issue $3,649,200 of mortgage notes to the federal government (REA) at 2 percent interest.

In its majority opinion, the Wisconsin commission held that the purchase would not be in the public interest because the area is lightly settled, so that the plant investment per customer will require higher rates to provide a reasonable return on the investment. It added that the co-op was over-optimistic in estimating future earnings. As for the $500,000 to $1,000,000 needed to rehabilitate the properties, the co-op has "an insufficient depreciation reserve for replacement of the property as the need arises."

To the contention made by proponents of the sale that the federal government is the only investor and that no protection is needed as far as sale of securities, the commission said:

"This contention ignores the fact that the risk of federal funds contributed by the taxpayers of the nation is involved in the proposed loan. Regardless of who the immediate prospective purchaser of securities issued by public service corporations may be, the commission has consistently held that the protection required by the statutes should be applied in favor of all possible investors."

The minority opinion held that the commission rulings dealing with public utility corporations organized for profit should not be applied, argued that the cooperative movement should be fostered, and that the co-op, despite the admittedly higher purchase price, would because of tax exemption and the plowing back of profits into the enterprise be in a more favorable position after a period of years than a privately owned utility purchaser and thus would be better able to serve the public.

•

Cooperative Changes Name

To comply with a technicality in the sale of northeastern Arizona power property, the Arizona Corporation Commission has approved the change in the trade name of the White Mountain Cooperative, Inc., to the Navopache Electric, Inc. The action was taken by the commission so the Navopache utility may complete a purchase of the Lakeside (Ariz.) Light & Power Co. When negotiations first were started for the purchase, the Navopache company was doing business as the White Mountain Co-operative, Inc. The property is part of the Herbert D. Lore estate.

Interdependence Endorsed by Electrical League Group

Gwilym A. Price Makes Address Commemorating Centennial Anniversary of Birth of George Westinghouse—Importance of Selling Stressed — W. G. Hills Elected to Presidency

How all the elements of the electrical industry depend on each other was the pervading theme of the eleventh annual conference of the International Association of Electrical Leagues, October 2-4, in New York. Carrying the thought outside the one industry, Gwilym A. Price, Westinghouse president, in an address commemorating the centennial anniversary of the birth of his company's founder, George Westinghouse, said:

"Business management has no greater task than to make clear the facts of interdependence. We cannot have national unity without unity on the local level. And the place to achieve that unity is in the individual business, in the development of confidence and trust and teamwork between manager and employee."

Wiring as Important as Appliances

An example of doing what Mr. Price advocated had been given in an earlier meeting by N. J. MacDonald, Thomas & Betts Co., and J. R. Poteat, General Electric Co., in a joint presentation of the theme which resulted in endorsement of the "Declaration of Electrical Interdependence" by the conference. To put across the modern idea of "Electrical Living," every person in the industry must get behind it, said Mr. MacDonald, and it must be realized, averred Mr. Poteat, that mass production, for instance, of wiring is just as important for success of the idea as is mass production of appliances.

These speakers were followed by four others, L. W. Davis, C. G. Pyle, W. J. Donald, and J. T. Coatesworth, representing respectively electrical contractors, wholesalers, manufacturers, and utilities, all supporting the idea of industry cooperation and pledging support of the movement whose purpose is stated in the "Declaration."

That interdependence extends outside the electrical industry was proven by the paper by Kenneth Cook, American Central Manufacturing Corp., on "Selling, Installing Complete Electric Kitchens," which concluded with specific recommendations for cooperation between the Electrical Leagues and the makers of non-electrical kitchen equipment, such as cabinets and sinks.

The sellers' market for electrical appliances is not going to last very long, said H. M. Kelley, Frigidaire Division, General Motors Corp., instancing the current increasing of time sales and the slowing up of buying already apparent in radios and vacuum cleaners and becoming so in washing machines. To date, appliance production has been far below expectations, and the prospect for immediate improvement is not good. When real volume production does come, a lot of selling will be needed to move the goods.

The electrical league directors present learned about heat pump house heating from S. W. Andrews, American Gas & Electric Service Corp.; about the market possibilities of commercial lighting from H. H. Green, Nela Park; about advances in industrial electrical applications from C. B. Stainback, Westinghouse Electric Corp.; about television and its load-building potentialities from A. B. Rodner, Commonwealth Edison Co.; about progress in adequate wiring from H. P. Vermilya, John B. Pierce Foundation.

New officers elected were, president, W. G. Hills, the Electric Institute of Washington, (D.C.); vice-president, S. E. Strunk, Electrical League of Cleveland; treasurer, C. H. Christine, St. Louis Electrical Board of Trade; secretary, O. C. Small, and assistant secretary, J. F. Biggi, both of NEMA.

Elected to the Board of Governors, which includes the officers, were G. W. Austen, Electric Service League of Ontario; R. B. Hubbard, Rocky Mountain Electrical League; J. Clark Chamberlain, Bureau of Radio and Electrical Appliances of San Diego (Cal.) County; J. A. Morrison, Electrical Association of Philadelphia; C. G. Odell, Electrical Association of Detroit; H. P. Wilson, Electric Institute of the Tri-Cities.

IN HONOR OF WESTINGHOUSE—H. C. Callahan, left, president, Electric and Gas Association of New York, and Gwilym A. Price, president, Westinghouse Electric Corp., at unveiling of bust of George Westinghouse at Conference of Electrical Leagues last week in New York

Surplus Army Equipment Rushed to Florida Utilities

Twenty-three heavy trucks and trailers, loaded with surplus Army power equipment, left Baltimore Monday for the hurricane-swept areas of Florida and Georgia. The equipment, ordered by four electric utilities, included materials to repair line destruction resulting from the storm and to provide emergency power for hospitals, water pumping and other urgent needs.

Some damage to power facilities already had been reported early Tuesday, as the hurricane struck inland from the Gulf of Mexico at Tampa. No over-all estimate of the damage was available as this was written, but there were reports of temporary power failures at Sarasota and other points.

The surplus army equipment in the Baltimore caravan was requested by the Florida Power & Light Co., Florida Power Corp., Georgia Power & Light Co., and Georgia Power Co. as the storm approached the Florida coast. Arrangements to complete the transaction, which disregarded all normal priorities, were made Monday afternoon by War Assets Administration, the Army and Civilian Production Administration. Hand-picked crews of drivers from commercial truck lines manned the caravan as it left the Holabird signal depot at Baltimore.

Vehicles in the caravan included: twelve ton-and-a-half electric utility line trucks, used by the Army for making line repairs; three ton-and-a-half earth augers, for drilling holes and setting up poles; three power vans, equipped with diesel-electric generating units which will provide emergency power to hospitals and for other purposes; four 2½-ton heavy duty pole trailers, and one low-bed trailer for hauling heavy transformers.

Exchange Program Suggests Answers for Utility Problems

Engineering and Operation Section of Southeastern Group Meets at Atlanta—Generating Capacity Shortage Worries Military Authorities — Oil-o-static Cable Line Discussed

MORE MECHANIZATION, more automatization, more ingenuity, and more sympathetic understanding between managements and employees were cited as dominant answers to the complex obstacles facing the electric utilities at a meeting of the Engineering and Operation Section of the Southeastern Electric Exchange in Atlanta on October 3 and 4.

Inflationary tendencies put a premium on hydro capacity, said S. C. McMeekin, South Carolina Electric & Gas Co., who added that personnel managers have unique importance under prevailing conditions.

The comprehensive and intensive employee training and informative program of Louisiana Power & Light Co. was detailed by W. H. Senyard with emphasis on the sustained and enthusiastic support of supervisory staffs. It was urged that best results can be obtained if information is full and free and if policy matters are committed to writing so that misinterpretation will be minimized. Employee faithfulness and loyalty should no more be allowed to waver and wane than should faint salesmanship lose an appliance sale.

Power Needed if War Comes

Quite general concern about the sufficiency of generating capacity for the large prospective loads was being felt by military authorities as denoting an even lesser ability to snap back into production for a sudden war than was manifested at the beginning of the latest one, said George Grimm of Florida Power Corp. He advocated continuation of area planning by the utilities to preclude the necessity of government agencies doing it.

Emphasis was placed by Ivan Buys, Virginia Electric & Power Co., on mechanization to meet the rising costs of rural and other construction. Buys stressed the need for light-weight hole diggers and pole setters for rural lines. W. P. Postell, Alabama Power Co., doubted if any new designs of trucks would be available before 1948, urged the companies in comparable territory to standardize on body designs, and questioned the value of an excessive number of boxes lest they be filled with junk rather than necessities. He sees a growing problem in meter reading in thin inaccessible rural districts.

Choice and installation of the 5-mile run of 110-kv. Oil-o-static cable in Atlanta were discussed by R. O. Loomis and P. B. Boyd. Their papers will be adapted for publication in ELECTRICAL WORLD. Miami is to have some 29 miles of aerial cable (4 to 13 kv.) and P. J. Carlin reported that his studies place preference on the spinner method of installation although part of the mileage will be preassembled; part will be polyethylene. James White, Appalachian Electric Power Co., said that aerial cable that was figured to pay for itself in five years, in terms of heavier expenditure averted, had already given twelve years of service.

Outline of the heat pump program was given by E. R. Ambrose, American Gas & Electric Service, who reported that soil conduction and other studies would be prosecuted by the utility group while manufacturers are evolving the apparatus to fit the latest specifications.

Among things projected for application in Jackson, Miss., distribution by P. G. Whitmore, Ebasco Services, were: ten ducts arranged in U-shape for better heat dissipation, a bent-pipe cluster as a vault entrance for aerial cable, and three-level relaying of the breakers in the mesh.

THE CLARK HILL PROPOSAL

And What It Means to Georgia

The Savannah River Electric Company proposes to build a great dam and power house on the Savannah River, above Augusta, at a cost of about $45,000,000. It proposes to complete the project within three and a half years from the time the license is granted by the Federal Power Commission.

Here are some facts about the development in which you will be interested:

1. The power plant would have an immediate capacity of 160,000 horsepower and an ultimate capacity of 375,000 horsepower. The power would be sold to the Georgia and South Carolina Power Companies at cost and be distributed by them at rates fixed by state regulation. These two companies have a ready market for the power.

2. In the building of the dam, the plans of the Army Engineers would be generally followed and water would be released under government supervision. *Thus all benefits of navigation and flood control would be fully realized.*

3. A great public recreational area would be available along the 78,000-acre lake extending 40 miles up the Savannah River.

4. The entire development would be subject to all federal, state and local taxes. This is a very important consideration for the seven counties whose lands would be included in the reservoir. Government pays no taxes.

5. Under President Truman's economy program, the development by the government might be postponed indefinitely. The Savannah River Electric Company can go ahead as soon as it gets a license.

The people of the Savannah River basin have everything to gain from this proposition. Consider it carefully and give it your support.

SAVANNAH RIVER ELECTRIC COMPANY

P. S. Arkwright, President

TELLING THE PUBLIC—Savannah River Electric Co. has turned to newspaper advertising to gain popular support for its proposed Clark Hill project for which it is seeking a FPC license. This is one of a series of advertisements

Second National Electronics Conference Held at Chicago

Power Applications Included Among Technical Papers—Plans for Annual National Forum Advanced—Attendance Totals 2,500 —Many Electronic Applications Described and Discussed

AFTER a lapse of one year due to travel restrictions, plans for an annual national forum on electronics were again advanced at a gathering of more than 2,500 scientists, engineers, and educators for a program of technical papers and discussions at the National Electronics Conference in Chicago last week. As in 1944, the three-day meeting was locally sponsored, with Illinois Institute of Technology, Northwestern University, the University of Illinois, and Chicago sections of the Institute of Radio Engineers and American Institute of Electrical Engineers, and the Chicago Technical Societies Council represented on the arrangement committees.

While a majority of the 60 papers were on the subjects of radio, television, and related development, several of the 19 subject sessions were devoted entirely to power and industrial uses of electronic circuits. A large manufacturers' exhibit added interest to the conference.

Divisions of Electronics

E. U. Condon, director of the National Bureau of Standards, outlined electronics in eleven subdivisions, with seven still in the science stage. Radio and communication and power rectification are well advanced, with inductive and dielectric heating and electronic instrumentation in the early stages of development. We are only on the frontiers of knowledge, without the slightest idea of the results to be expected and with experiences ahead at least as exciting as the exploration of power in the two or three decades just closed, he believes.

This opinion was extended also by C. G. Suits, General Electric Co. in predicting that "new segments of the electronics industry in the offing will ultimately be more important in their magnitude than the radio broadcasting industry is at present." As an example, he reviewed development of the magnetron to make available kilowatts of power in the kilocycle range. He predicted use of high-frequency units in the kitchen for quick heating of precooked frozen foods.

A new type of frequency converter for melting furnace and forging heater application was described by R. J. Ballard and J. L. Boyer, Westinghouse Electric Corp. High efficiency, quiet operation, light weight, and low starting demand are some of the desirable features of 3-phase, 60-cycle power conversion direct to single-phase, high-frequency power. It is now possible to supply the entire field of induction heating and melting with power from electronic equipment, they concluded.

Another example of heating was described by D. E. Watts, T. N. Willcox, and G. F. Leland, General Electric. Their paper presented suggestions for use of preheaters in the plastics industry to improve molding cycles and factory operation. Problems of the equipment were analyzed to show factors required in a preheater design.

E. T. Neubauer, Allis-Chalmers Manufacturing Co., outlined the difficulties of nuclear power plant engineering. A major problem of using atomic energy for electrical generation is to develop a heat transfer medium, which he thought may be solved in a manner similar to air-conditioning installations. A fluid, which would not absorb radiation, would be kept in a confined space and act through a second heat transfer for conversion to mechanical energy. The great challenge to the scientist is to by-pass these problems by direct conversion of nuclear energy into electrical energy, he concluded.

M. M. Morack, General Electric, found that the d.c. motor, instead of shrinking into insignificance, is gaining in popularity. The trend is, however, not to provide a d.c. power distribution system, but to distribute a.c. power and to convert to d.c. power for individual motor drives. The development of rectifiers now permits the extension of electronic drives up to 600 hp.

W. H. Elliot, Cutler-Hammer, Inc., reviewed the basic electronic circuits which may be used to control the more common types of a.c. motors and gave particular attention to the speed control of wound-rotor motors. Installations of this type have been in ratings up to 150 hp.

•

WAA Acts to Get Surplus Property for Vets Housing

War Assets Administration moved this week to accelerate disposal of all surplus government property suitable for housing, including materials used by electric utilities, into the veterans housing program.

WAA's 33 regional directors have been ordered to take inventories of materials of this type, which then will be held for ten days to give Federal Public Housing Authority and the Veterans Administration time to obtain it for veterans housing and hospital projects. The remaining materials and supplies will be sold, during an initial offering period, only to buyers certified by the Civilian Production Administration for construction of veterans' homes or hospitals.

PROMINENT AT ELECTRONICS CONFERENCE—J. E. Hobson, left, Armour Research Foundation, and W. O. Swinyard, Hazeltine Research, Inc., directed activities. E. U. Condon, National Bureau of Standards, addressed the session. A. B. Bronwell, Northwestern University, chairman of the Program Committee

Operating, Design Techniques Show Advances in Utility Field

E.E.I. Equipment Committee Considers System Engineering, Apparatus Improvements, and Improved Practices at Meeting at Swampscott, Mass.—Foreign Work Gets Place on Program

Discussions ranging from actuarial studies of turbo-generator outages to d.c. transmission developments in Europe occupied the close attention of 75 engineers last week at the Edison Electric Institute Equipment Committee meeting at Swampscott, Mass.

H. P. Seelye, Detroit Edison Co., presented a paper analyzing the operating records of 26 major generating units ranging from 10 to 75 mw. in rating as a basis of predicting outages and an indication of necessary reserve capacity. Relatively simple formulas were developed to compute outage expectancy. Age of equipment had little effect on outage incidence. Critical levels of reserve were indicated, above which the addition of substantial units of capacity projected breakdown expectancy far into the future. The method was submitted as an aid to engineering judgment in addition to other factors influencing reserves, and not as an all-sufficient technique.

Connecticut Exchange Experience

E. C. Brown, manager, Connecticut Valley Power Exchange, Hartford, described the operations of this pioneer power pool, the methods of interchange of secondary and handling of primary power between three non-affiliated and two participating companies. The author advocated a middle ground in accounting for interchange power, avoiding complex procedures unless these pay their way, and also steering clear of short cuts ignoring involved equities. Oversimplification should not be followed back into the "horse trading" area of interchange operations. This non-corporate, voluntary association, organized in 1925, functioned in 1945 with a staff of nine men and women, with a 24-hr.-per-day load control office and many special assignments, in addition to acounting for 800 million kw.-hr. of interchange and primary power, of which the Exchange evaluated $3,250,000 worth.

Translations of several papers of Swedish origin, presented at a Paris conference this summer, which reviewed trends in high-voltage d.c. transmission as assembled by H. A. Dryar, Philadelphia Electric Co., were read to the committee. Future hydro developments in Sweden point toward transmissions of the order of 1,500 mw. and maximum distances of 400 to 600 miles. Large blocks of power and long distances are basic needs. Serious handicaps must be overcome in using ground return systems, in connection with electrolysis and telephone interference resulting often over great areas. Terminal equipment challenges designers' abilities.

Metal-clad switchgear came in for extended discussion. C. C. Dodge, Stone & Webster Engineering, described the installation at Venice No. 2 station of Union Electric Co. of Missouri. When WPB reinstated permission in 1945 to proceed with the construction of Section 3 at Venice, experience with 4,000- and 5,000-amp. circuit breakers in Sections 1 and 2, coupled with the elimination of oil fire hazard, led to the selection of all air breakers for Section 3. Metal-clad switchgear incorporated some of the safety advantages inherent in masonry construction, transferred a large labor item to the manufacturer, and enabled faults to be localized by complete separation of groups by masonry fire walls and gas-tight bushings at walls and floors, along with bus differential protection. Vigorous support of masonry construction was voiced in the general discussion, but present labor difficulties were recognized as obstacles.

A guide for specification on metal-clad switchgear was presented by E. B. Shew, Philadelphia Electric, on behalf of a working group on uniform requirements, including aid by the A.E.I.C. committee on switching and switchgear and cooperating manufacturers.

Summarized replies to a questionnaire on testing, sampling, and reclamation of insulating oil were presented by E. S. Fitz, Virginia Electric & Power Co. Widespread acceptance was noted of tests for dielectric condition, acidity, power factor and color; field tests bulked large in importance although shop and laboratory checkups predominated; and dielectric tests on transformers, breakers and bushings were general. Many divergencies in procedure and equipment were noted. Filter press treatment held its place in the front line.

•

Tampa Passes Utilities Tax

Tampa, Fla., has passed a 10 percent tax on all utility bills up to $250 and 2½ percent on bills over that amount.

MEETINGS

Previously Listed

International Association of Electrical Inspectors—Southern Section, George Vanderbilt Hotel, Asheville, N. C., October 14-16; Western Section, Gibson Hotel, Cincinnati, Ohio, October 21-23; Eastern Section, Mark Twain Hotel, Elmira, N. Y., October 28-30.

National Electrical Contractors Association—Annual meeting, Ritz Carlton, Atlantic City, N. J., October 14-18.

Electrochemical Society—Fall meeting, Royal York Hotel, Toronto, Canada, October 16-19.

Missouri Valley Electric Association—Rural Round-table Discussion, Hotel Continental, Kansas City, Mo., October 29; Fall sales and rural conference, Hotel Continental, Kansas City, Mo., October 30-31.

Edison Electric Institute—Accident prevention committee, Hotel Statler, Buffalo, N. Y., October 31-November 1.

Southeastern Electric Exchange—Accounting Section, Fort Sumter Hotel, Charleston, S. C., October 17-18; Commercial Section, Atlanta Biltmore Hotel, Atlanta, Ga., November 6-9.

American Welding Society—Annual meeting, New York, N. Y., October 24 and Atlantic City, N. J., November 17-22.

ASME-AIME Joint Fuels Conference — Bellevue-Stratford Hotel, Philadelphia, Pa., October 24-25.

Pennsylvania Electric Association—Electrical equipment committee, Lord Baltimore Hotel, Baltimore, Md., October 24-25; Transmission and distribution committee, Abraham Lincoln Hotel, Reading, Pa., October 24-25; Meter committee Benjamin Franklin Hotel, Philadelphia Pa., November 7-8; Systems operation committee, Skytop Lodge, Pa., November 7-8.

RLM Standards Institute—Annual meeting, Brighton Hotel, Atlantic City, N. J., October 28.

National Electrical Manufacturers Association—Annual meeting, Traymore Hotel, Atlantic City N. J., October 28-November 1.

National Farm Electrification Conference—Sherman Hotel, Chicago, Ill., November 7-8.

National Research Council—Conference on Electrical Insulation, Johns-Hopkins University Baltimore, Md., November 7-9.

National Association of Railroad and Utilities Commissioners—Annual meeting, New Orleans La., November 12-15.

New Jersey Utilities Association—Annual meeting, Seaview Country Club, Absecon, N. J., November 22-23.

National Exposition of Power and Mechanical Engineering—Grand Central Palace, New York, N. Y., December 2-7.

SEC RULINGS

The Securities and Exchange Commission recently issued a series of orders affecting electric utility companies.

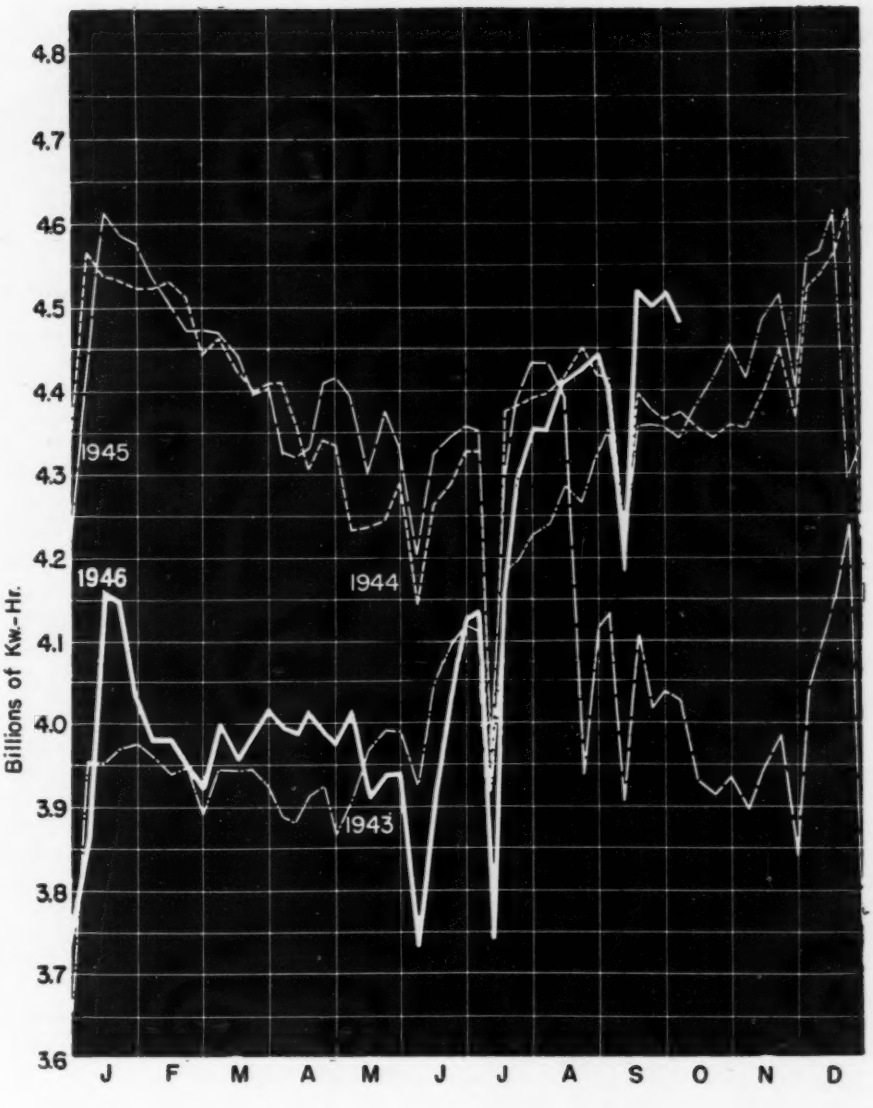
CENTRAL NEW YORK POWER CORP. and HAMMOND LIGHT & POWER CO.'s (a subsidiary) joint application has been approved. Central, which at present owns 54 shares (54%) of the common stock of Hammond, proposed to purchase from Oswegatchie Light & Power Co., a nonaffiliate, for a cash consideration of $12,466 ($271 per share), the remaining outstanding 46 shares of Hammond common stock. Upon acquisition of these shares, it is proposed that Hammond be merged into Central. (Release No. 6906).

UNITED PUBLIC UTILITIES CORP.'s plan to pay $16 a share on preferred stocks as a payment out of capital and to distribute $6.63 a share on the $3 preferred and $6.0775 a share on the $2.75 preferred in satisfaction of unpaid dividends on the issues will be approved by SEC, subject to an amendment to be filed by the company. The amendment, which the commission has indicated is acceptable to the company, is that the capital distribution is not to be described as a 32 percent reduction of preferred stockholders' claims, to liquidating value of $50 a share, as was stipulated in the company's amended plan filed in February. On the contrary, proposed alterations and modifications of the rights of preferred stockholders are to be subject to such adjustments which the commission, subject to court review, subsequently determines to be fair and equitable. The payment against arrears is to require $948,952, all to be charged to earned surplus. The capital distribution of $2,382,720 constitutes the remaining proceeds from sale of the company's Dakota properties. (Release No. 6908).

GREAT LAKES UTILITIES CO.'s request for permission to withdraw an amended plan filed on October 1, 1944, which provided, among other things, for the distribution of cash and a portion of its investments in its subsidiaries to its bondholders in full satisfaction of their claims, has been granted. Since the plan was filed Great Lakes sold its investment in one of its subsidiaries, Ohio Gas Light & Coke Co., and used a portion of the proceeds to satisfy in full the claims of its bondholders. (Release No. 6918).

MINNESOTA POWER & LIGHT CO.'s proposal to use treasury funds to redeem 9,000 shares of the 125,000 outstanding shares of its 5 percent preferred stock at the redemption price of $104.50 a share, plus accrued dividends, has been approved. The shares of stock to be redeemed are to be selected by lot and, upon acquisition, are to be cancelled. Minnesota is a subsidiary of American Power & Light Co. (Release No. 6913).

INTERSTATE POWER CO.'s proposal to sell to Gerald L. Schlessman, of Denver, all the gas properties and rights owned by Interstate in and near the city of Waseca, Minn., consisting of a natural gas pipe line and distribution system for $210,605, subject to closing adjustments, has been approved. Interstate Power Co. is a subsidiary of Ogden Corp. (Release No. 6916).



Output Curve Hits New High for October

Despite the fact that the electric output curve lost ground during the week ended October 5, 1946, it still reached the highest point ever recorded for the month of October.

The amount of electrical energy distributed by the light and power industry during the week, according to figures released by the Edison Electric Institute, amounted to 4,478,092,000 kw.-hr., compared with 4,517,874,000 kw.hr. during the preceding week and with 4,028,286,000 kw.-hr. during the corresponding week of 1945, that of October 6. The increase for the country as a whole for the week ended October 5 as compared with the corresponding week of last year was 11.2 percent.

The seven major geographical regions of the country all reported increases over the previous year. The percent changes from the previous year for the week ended October 5, as compared with those for the week ended September 28, were unsubstantial for the most part but the Pacific Coast group showed a drop to 12.2 percent from 16.8 percent.

Weekly Output, Millions Kw.-Hr.

1946		1945		1944	
Oct. 5	4,478	Oct. 6	4,028	Oct. 7	4,375
Sept. 28	4,518	Sept. 29	4,039	Sept. 30	4,366
Sept. 21	4,507	Sept. 22	4,019	Sept. 23	4,377
Sept. 14	4,521	Sept. 15	4,106	Sept. 16	4,395
Sept. 7	4,184	Sept. 8	3,909	Sept. 9	4,228
Aug. 31	4,404	Sept. 1	4,137	Sept. 2	4,415
Aug. 24	4,444	Aug. 25	4,116	Aug. 26	4,418
Aug. 17	4,422	Aug. 18	3,939	Aug. 19	4,451
Aug. 10	4,412	Aug. 11	4,395	Aug. 12	4,415
Aug. 3	4,351	Aug. 4	4,432	Aug. 5	4,399
July 27	4,352	July 28	4,435	July 29	4,391
July 20	4,293	July 21	4,385	July 22	4,381

Percent Change from Previous Year

	Oct. 5	Sept. 28	Sept .21
New England	+ 9.9	+ 9.7	+11.2
Mid-Atlantic	+ 7.8	+ 8.9	+ 7.0
Central Industrial	+ 8.1	+ 9.6	+11.6
West Central	+ 9.3	+ 9.0	+ 9.6
Southern States	+19.5	+17.3	+18.0
Rocky Mountain	+ 4.3	+ 1.2	+ 3.5
Pacific Coast	+12.2	+16.8	+14.6
Total United States.	+11.2	+11.9	+12.1

Ohio Public Service Union Strikes at Warren Station

A meeting of the striking local of the Utility Workers Union, C.I.O., was to be held Wednesday night to determine whether the walkout started at 6 a.m. Monday, at the Mahoningside plant of the Ohio Public Service Co. at Warren, Ohio, would be called off. The meeting call came after representatives of the United States Conciliation Service had prevailed upon union leaders to take this step pending vote of employees on a bargaining agent. Such an election has been ordered by the NLRB with the promise that it would be held prior to November 2.

The strike of the 150 employees seriously crippled industries in Warren and Niles. Three large companies affected were the Republic Steel Corp., Thomas Steel Co., and Copperweld Steel Co. Supervisory employees of the utility kept the plant operating at a point sufficient to provide power for domestic and emergency uses. No dimout was ordered, but President R. E. Burger of the utility appealed to customers to conserve power.

There was no indication that the strike would spread to other OPS plants nor was power coming through interconnections halted.

Back of the whole picture is the utility's argument for a company-wide election to determine a single bargaining agent; otherwise C.I.O. plus two A.F.L. affiliates, International Union of Operating Engineers and International Brotherhood of Electrical Workers, will have contracts. C.I.O. claims 92 percent of Warren employees while the two A.F.L. are dominant in other sections of the system with the Engineers rumored to have enough strength to win a company-wide election.

President Burger claims Ohio Public Service was advised by the NLRB to break off negotiations with all unions in May, 1946, until a proper bargaining agency could be named. He also denied C.I.O. claims that workers, who are asking 18 cents more an hour, are receiving substandard wages.

The strike came at an inopportune moment for the company because the only generating unit at the Dilles Bottom plant is down for overhaul, and the other 65,000-kw. unit there has not been installed.

•

Voters Reject Utility Tax

By a vote of 549 to 1,189, Gainesville, Ga., voters have rejected a proposed $1,000,000 city improvement program to be financed by a 10 percent tax on utility bills. Because the question was placed on the ballot merely to test public sentiment, the vote is not binding on the commission. But with sentiment more than two-to-one against the program, observers believe there is little chance the commission will adopt it.

•

Electric Energy Sales Drop 4.1 Percent in July

Sales of electric energy to ultimate customers in July, 1946, totaled 15,607,960,000 kw.-hr., compared with 16,274,194,000 kw.-hr. in July, 1945, a decrease of 4.1 percent, according to the report issued by the Edison Electric Institute.

Classification of Sales, July, 1946 and Change from 1945

Kilowatt-hour sales July	Million Kw.-Hr. 1946	1945	% Change
Residential or domestic	2,883	2,603	+10.8
Rural (Distinct rural rates)	470	375	+25.3
Commercial or industrial			
Small light & power	2,718	2,439	+11.5
Large light & power	8,309	9,463	−12.2
Street & highway lighting	154	149	+ 3.1
Other public authorities	464	640	−27.4
Railways & railroads			
Street & interurban	345	344	+ 0.4
Electrified steam railroads	213	217	− 1.8
Interdepartmental	52	45	+14.9
Total to ult. customers	15,608	16,274	− 4.1

Revenue from ultimate customers amounted to $279,659,300 in July, compared with $274,355,900 in July, 1945, an increase of 1.9 percent.

For the twelve months ended July 31, 1946, the average use per customer advanced to 1,295 kw.-hr. from 1,191 kw.-hr. for the preceding year, an increase of 8.7 percent; the average annual bill to $42.61 from $41.33, an increase of 3.1 percent; revenue per kilowatt-hour dropped to 3.29 cents per kilowatt-hour from 3.47 cents, a decrease of 5.2 percent.

•

Western Massachusetts Electric Will Build Station

Western Massachusetts Electric Co., Springfield, is planning to build a new steam generating plant on a 22-acre site purchased in 1927 on the west bank of the Connecticut River in West Springfield, opposite the existing State Street steam plant.

The initial unit will be rated at 40,000 kw., and it is expected that nearly three years will be required for the engineering and construction. Ample space for expansion and fuel storage is available at the site, which is also the location of a major switching station of the company, where important transmission lines from Connecticut and the upper Connecticut River valley terminate.

Atomic Energy for Power —Not for at Least 10 Years

Challenging developments in power generation occupied an important part on the program of the fall meeting of the American Society of Mechanical Engineers last week at Boston.

Honorary membership was conferred upon Ralph E. Flanders, Jones & Lamson, and on Irving E. Moultrop, retired chief engineer of the Boston Edison Co. and now a consulting engineer at Belmont, Mass.

H. A. Winne, vice-president in charge of engineering policy, General Electric Co., and electric chief on atomic power at Oak Ridge and Hanford, predicted that the introduction of atomic power into the American economy will be very gradual and not at all upsetting to the utility industry. Though an experimental plant is already being engineered at Oak Ridge, Tenn., from one to three decades may be required to establish nuclear power as an important factor in energy production.

A similar prediction was made by A. C. Klein, engineering manager, Stone & Webster Engineering Corp. He predicted that it will be approximately ten years before atomic energy will have any effect on electricity costs. Coal and other fuels will be supplanted only to a limited extent. There is room enough in the growth of our demand for power to absorb all the uranium that will be produced and at the same time to keep coal mines, oil wells, and hydro plants operating at normal capacity.

The first commercial plants to be built may be of the order of 1,000,000 kw. interconnected with several of our largest public utility systems.

•

Taxes Come to Wickenburg as Utility Revenues Drop

Loss of its electrical utility business outside of the town limits and lowering of rates has made it necessary for Wickenburg, Ariz., to levy a property tax for the first time in years to meet expenses.

The town authorities recently asked the Arizona Tax Commission to set the tax rate, which it can do under the law because there had been none in the previous year. The rate was placed at $2.19 per $100 assessed valuation.

The town lost much of its utility business when the Central Arizona Light and Power Co. built a competing line into the suburban territory the municipal lines had previously served.

The private utility offered to purchase the town's plant, but the offer was voted down by a wide margin last winter.

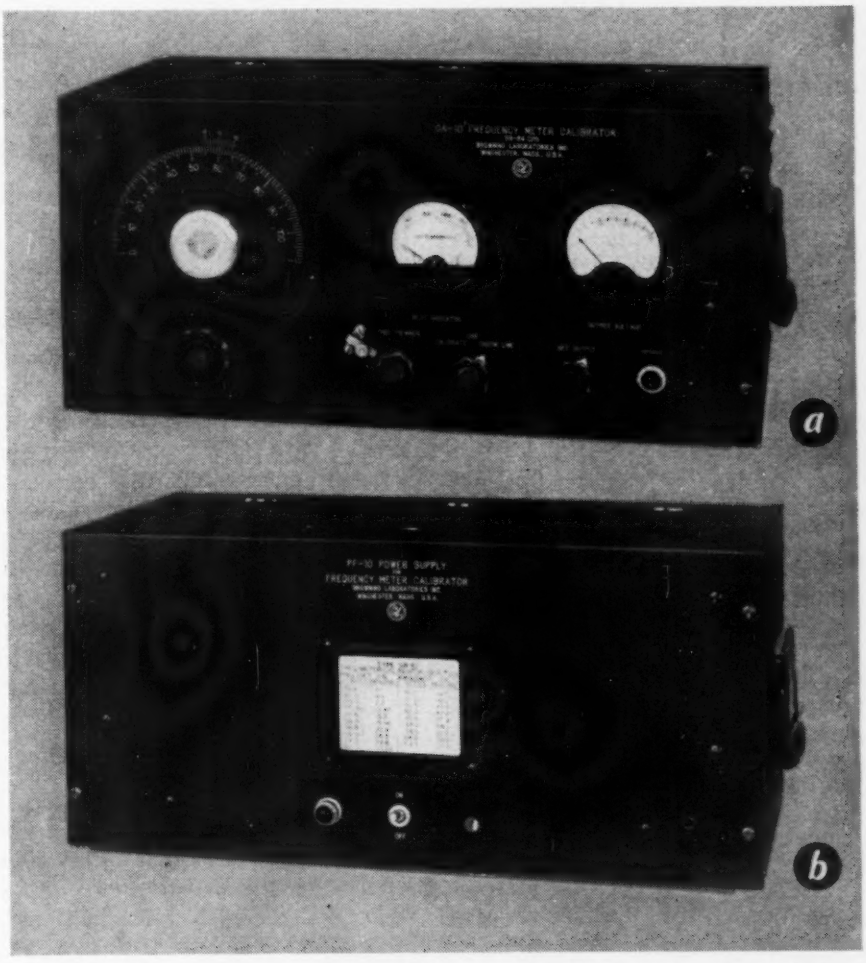
Calibration of Frequency Meters

CORRECTIVE MEASURES taken by local operators (with or without communication) to reestablish tie lines and capacity call for a fairly wide range of accurate frequency determination. This means having all frequency meters read accurately on several points as well as at 60 cycles. Recent introduction of the frequency calibrator (Browning Laboratories, Inc., Winchester, Mass.) facilitates field testing of such meters and makes laboratory tests less expensive. This calibrator (GA-10) provides a portable standard with an accuracy of plus or minus 0.05 percent over its entire range (56-64 cycles), for generating variable frequency in the central station field. In addition, it is also useful in connection with the accurate setting of low and high-frequency relays, automatic phasing relays and phase check relays. Other applications are likely to develop in the electronic area.

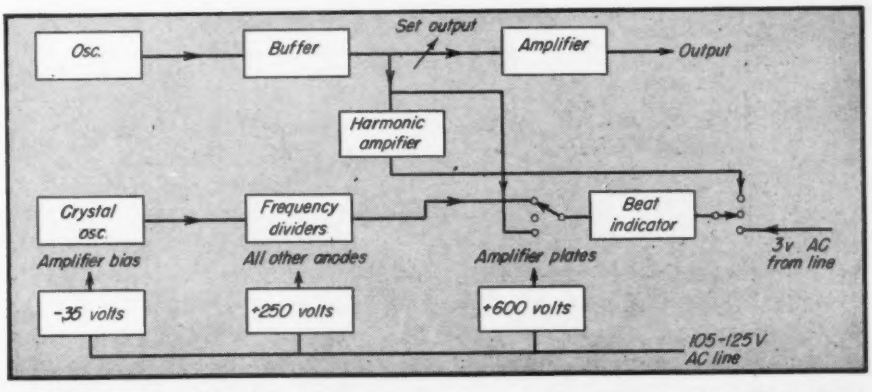
A Frequency Source

This calibrator can be used as an accurate frequency source with an output up to 25 volt-amp. and an output voltage adjustable from 130 to 100 volts. Filters requiring accurate adjustments may be set by this equipment, which can also be made on special order to cover any narrow range of audio frequencies with the same accuracy and stability.

In general, the calibrator operation (see block diagram) is as follows: A 3-section power unit supplies all requirements. A 600-volt unregulated unit provides plate supply for the power amplifier at about 150 ma.; a second regulated section provides 250 volts at 80 ma. for all other tube plates plus the power amplifier screens; and a third section provides negative voltage at 35 volts for power amplifier grid bias. Sine wave output over the required frequency range



VIEW OF (a) frequency meter calibrator, and (b) power-supply unit for use with calibrator; unit provides a portable standard



BLOCK DIAGRAM of equipment arrangement in frequency meter calibration

is generated by the block *osc.*, electrical isolation being furnished by the block *buffer*. Voltage level to the amplifier is controlled by the *set output* control. The amplifier is then transformer-coupled to the load.

A portion of the *buffer* output is distorted and amplified in order to obtain higher order harmonics in the block *harmonic amp*. This known harmonic provides a means of comparing the fundamental oscillator frequency with the extremely stable base frequency obtained by a *crystal osc.* through suitable *frequency dividers*. Actual comparison of the *osc.* harmonic with the sub-multiples of the *crystal osc.* is carried out in a section marked *beat indicator*. By turning the selector switch from the initial *calibrate* position to that marked *check line*, comparisons are made between the fundamental *osc.* output and the line frequency which supplies input power to the calibrator. Again the *beat indicator* serves as the means of comparison. The beat is detected and indicated on a sensitive d.c. meter. The oscillator may be adjusted to the original calibration curve by means of an auxiliary control. Maintenance of accuracy, minimum warm-up time are assured.

Line frequency may be determined to plus or minus 0.03 cycles per sec. by using the same procedure as standardizing the oscillator. In this case, the oscillator output is directly compared with line frequency.

• • •

Industrial Plant

Combined Power and Light—II*

L. C. PETERMAN,
Electrical Engineer,
Ford, Bacon & Davis Inc., New York, N. Y.

IN A PREVIOUS ISSUE methods (a) and (b) for the distribution of alternating current for lighting and power were described.

Method (c) has proven economical and highly satisfactory in many plants of diverse characteristics. It is particularly advantageous where the power load is three times the size of the lighting load or more. Principal savings are in the reduction in copper due to distribution of lighting load at power voltage and reduction in number of substations and increase in their size due to the greater radius of distribution at the higher voltage. These savings usually more than offset the cost of the transformers.

A few case histories may be of interest.

Case (1). A 460-volt installation saved $5,000 or 10 percent as compared to cost of a system with two 120/208-volt substations. It saved $10,000 or 20 percent as compared to cost of one 460-volt and one 120/208-volt substation.

Case (2). A plant with 750-kva. demand, nearly all lighting and 230-volt motors (only elevator motors were on 460 volts) saved $5,000 for 460-volt distribution as compared with 120/208-volt distribution or 4 percent.

Case (3). A job in which nine 1,000-kva., 460-volt substations were installed for power and lighting would have required 14 substations if lighting and power had been separated. Of the 14, five would have been 1,000 kva., four would have been 750 kva. and six would have been 300 kva. or a total of 9,800 kva.; and the 9,800 would have been more expensive by far than the nine 1,000's. That is one advantage of the single 460-volt system for light and power, elimination of one complete system and concentration of necessary substation capacity in a smaller number of large units. The saving in this case was in excess of $25,000.

Usually the lighting feeders are arranged to feed six or nine single-phase transformers all of the same size, balanced across the three phases. Lighting panels are 3-wire grounded neutral, located immediately under the associated transformer. The transformer and lighting cabinet may be located on building columns or walls, but each feeds load in the immediate vicinity. Ordinarily 15- or 25-kva. transformers are used, with one breaker at the 460-volt substation but no disconnecting switches or fuses at the individual transformer.

The transformer and its associated lighting cabinet are considered a unit and number of circuits in the latter is matched to the capacity of the transformer. As far as possible all lighting feeders, transformers and lighting cabinets are made the same size throughout each installation.

A discussion of method (d) in a subsequent article will conclude this series on industrial a.c. distribution.

* This series began in ELECTRICAL WORLD, September 28, 1946, page 130.

• • •

Magnify Details in a Wave Form

RUDOLF FELDT,
Head, Applications Engineering Dept.
Allen B. DuMont Laboratories, Inc.
Passaic, N. J.

ANALYSIS of complex wave forms occasionally requires magnification of small details which may be significant. AN example would be the examination in detail of very high harmonics on power lines.

Two ways to expand the image on the screen of a cathode-ray tube are (1) to increase the sweep amplitude or (2) to increase the sweep frequency. The first method is limited by the point of overload of the amplifier, the second by the fact that increasing sweep frequency complicates the image and makes interpretation difficult, if not impossible. This phenomenon is illustrated in Fig. 1, which describes the appearance of a sine wave (frequency F) when a sweep frequency of F (Fig. 1a) or nxF (Fig. 1b) is used. When the sweep frequency is nxF, each one of the n pattern elements, which correspond to n equal time elements, is spread out over the entire screen.

In order to construct the pattern

shown in Fig. 1b, the time base must be divided into n parts. Each point of division is then projected vertically so as to intersect the sine wave. These sine wave intersection points are then projected horizontally to alternate sides of the second screen. Diagonals are constructed connecting the points in numerical succession. The resultant pattern indicates how intricate the image becomes in the case of a simple sine wave. Complicated wave forms produce patterns which are unintelligible and practically useless.

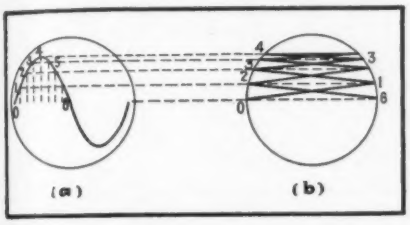


FIG. 1—Oscillogram of a sine wave; (a) when signal frequency = F and sweep frequency = F, (b) when signal frequency = F and sweep frequency = n x F

The basic ideas of this method are the use of the high speed sweep for magnification and the elimination of confusion by singling out one time element and suppressing the rest. This is accomplished by applying short positive pulses to the grid of the cathode-ray tube at a repetitive rate equal to the fundamental frequency of the signal under observation. The tube is biased to cut off and consequently is illuminated only during the "on" period of the pulses. Any part of the oscillogram can be made visible by merely shifting the positive grid pulses by means of a phase shifting device.

A practical example is an investigation of a 60-cycle wave containing a large number of high frequency harmonics (the voltage across a fluorescent lamp obtained by capacitive coupling). These harmonics are to be examined closely. One wave element is selected and the foregoing procedure is followed. On the oscillogram only the section of the wave covered by the pulse remains visible, i.e., in a vertical pattern. Then the line-like pulse is extended in a diagonal pattern over the entire screen. To obtain the latter pattern, the sweep frequency is increased to approximately 5,000 cps., corresponding to a magnification of 83.

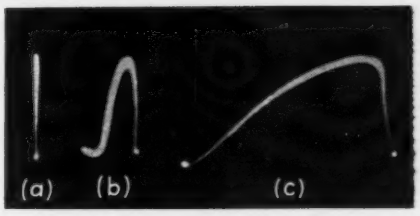


FIG. 2—Single pulse or high frequency harmonic (a) on an oscillogram. As sweep frequency is increased the pulse is extended gradually (b) over the entire (c) screen

• • •

White Paint Raises Light Intensity 25%

ADEQUATE, uniform light all day, all night, all year was a major consideration in the design and construction of the celebrated Windowless "Controlled Conditions" Plant of Simonds Saw and Steel Co. in Fitchburg, Mass.

The problem involved provision of shadowless lighting for an area 560 ft. long by 360 ft. wide with an average ceiling of 28 ft. In this 4.75 acres of floor space under a single roof, production by precision cutting tools, including step-by-step inspection and testing, was planned in 72 bays, each 40 ft. by 70 ft.

Fluorescent lighting was selected as the most practical and effective system. The actual installation consisted of some 1,500 Cooper-Hewitt 100-watt mercury vapor tubes mounted in General Electric reflectors about 13 ft. above the floor and spaced approximately 10 ft. by 12 ft. apart. In operation, tube life averages approximately 4,800 hr.

Originally, the ceiling (208,000 sq. ft.) was painted ivory; the walls (50,000 sq. ft.) an off-white; upper structure, columns, and overhead visitors' walkway an apple green. Although an acceptable lighting intensity was obtained, an extended study revealed that an over-all use of white paint would not only improve light reflection but make for more even light distribution. Using "Barreled Sunlight" (U. S. Gutta Percha Paint Co. product) applied by both brush and spray, the entire interior right down to the floor was painted pure white by the Frank L. Adams Co. of Worcester, Mass.

The results were better than hoped for. Lighting intensity in all 72 bays was increased from 20 foot-candles 3 ft. above the floor to 25 foot-candles with greatly improved quality of distribution. This is all the more remarkable considering that there was no change in the purely direct lighting system and the original color scheme has a fairly high reflectivity rating.

Operating 144 hr. a week, plant consumption for lighting alone averages 21,600 kw.-hr., with a demand of 150 kw., and a lighting power factor of 90 percent. Energy is purchased from the Fitchburg Gas & Electric Light Co.

TYPICAL BAY in Simonds Saw and Steel Co. windowless plant, where repainting with white coloring improved illumination throughout 4.75-acre production room without change in lighting installation

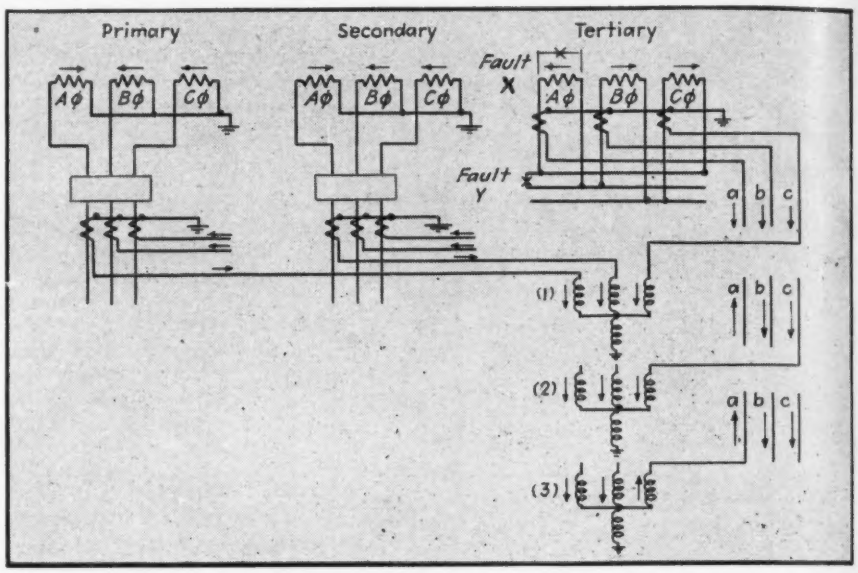
Differential Relay Protection Extended to Tertiary Winding

J. R. LINDERS
Senior Relay Engineer
The Cleveland Electric Illuminating Co.
Cleveland, Ohio

CONNECTION of differential relay protection for three single-phase three-winding transformers can be made to include the delta bus, which is normally outside the protected zone. A minor reconnection of the differential current circuits will extend the zone to include this bus and still provide normal operation for all other internal and external faults.

This unconventional connection has been in use approximately three years at four stations involving eight transformer banks of the Cleveland Electric Illuminating Co. transmission system. Although no tertiary bus faults have occurred in this time, there have been approximately 150 faults outside the differentially protected zones. No incorrect operation of the differential relays resulted from any of these faults.

Analysis of the relative instantaneous currents from the current transformers in the delta winding shows that the currents in all three phases are always equal and in phase except for faults on the tertiary bus structure itself. It therefore follows that if each current transformer in the delta winding is reconnected to the relay of another phase, as for example, "A" phase current transformer to "B" phase differential relay, "B" phase to "C" phase relay, and "C" phase to "A" phase relay, then normal relay operation will result for all internal or external faults except that a fault on the tertiary bus will cause currents to flow in the differential relays and isolate the fault from the system.



RELATIVE INSTANTANEOUS CURRENTS in differential relay protecting three-winding transformer bank. Relay for "A" phase only shown
(1) for fault on tertiary winding (X)
(2) for fault on tertiary bus (Y)
(3) same as (2), with conventional connection

The accompanying figure shows the connections for one relay with relative instantaneous currents indicated for two types of faults.

Normal differential relay operation is obtained for faults which are not on the tertiary bus. With a fault in the winding, as at point (X), the currents are equal and in the same direction in all three phases from the tertiary (1), although they may have different relative magnitude and direction for different locations of faults.

With a fault on the tertiary bus, as at point (Y), the currents from the tertiary are not equal or in phase. By connecting "C" phase current transformer to "A" phase relay etc., advantage is taken of the different magnitude and direction of the currents, (2). Current will flow in the operating coil of the differential relay which will then isolate the fault from the system.

In (3) the conventional connections are shown with the fault on the tertiary bus (Y). The currents to the differential relay will balance and the relay will not operate.

Although no loads of any sort are taken off the buses which have been protected in the manner described, it should be feasible to supply station service loads from this bus providing a fast-clearing fuse is used which will sequence with the differential relays.

Thy-mo-trol Equipment Facilitates Wire Winding

PRODUCTION of wire has been more than tripled per winding line since the mechanical equipment was redesigned and four 1-hp. and four 2-hp. Thy-mo-trol wire-winding units were installed at Jones & Laughlin's Wire Rope Division, Muncy, Pa. Taking 0.041-in. wire as the average, the eight new wire-winding lines and the remaining older lines now wind 80,000 to 125,000 lb. or well over 4,000 miles of wire, in a period of 24 hr.

Previously all wire at the plant had been wound on group-winding machines, each consisting of six winding bobbins and six unwinding swifts. The bobbins were driven by one constant-speed induction motor, through line shafts, gears, and individual disconnecting clutches, so that the wire speed increased as the wire continued to build up on the bobbin. The disadvantages of this arrangement were low average winding speeds, the difficulty of obtaining uniform winding tension, and high mechanical maintenance, since a breakdown on one machine put six lines out of order.

With the new equipment, the bobbin motor on each of four lines is rated 1 hp., 690/1,380 rpm., 230 volts, d.c., while those on each of the four

The new, metal-enclosed drawout air circuit breaker switchboard is modern, safe, easy to operate—*with plenty of interrupting capacity.*

ordered this METAL-CLAD "INSURANCE" against power failure

When this modern G-E switchboard arrived at the plant, it was completely assembled. The plant electricians installed it over a weekend and it was ready to take over the full plant load Monday morning.

Since that weekend, the cares—and repairs—of the plant electrician have diminished, for the drawout air breakers of the new switchgear have ample interrupting capacity to handle any heavy short circuits, and complete metal-enclosure of live parts sharply reduces the possibility of "shorts."

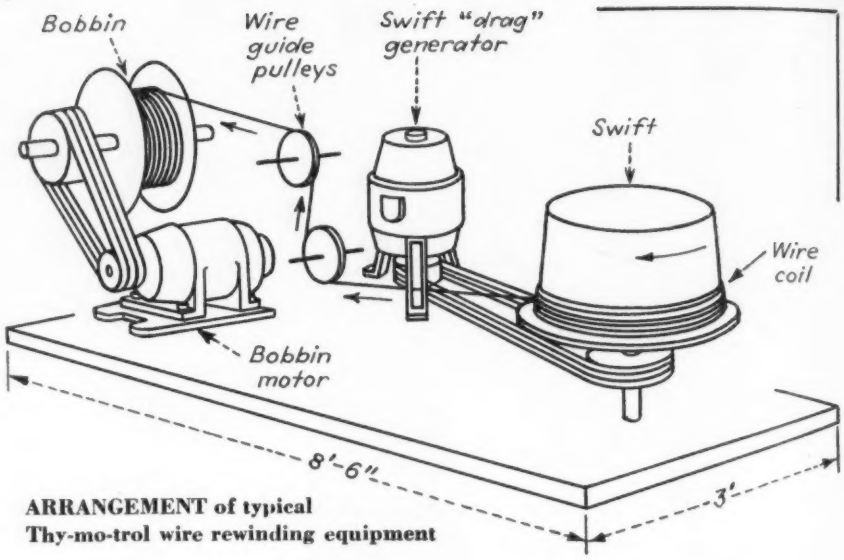
The electrician and his men have gone from the defensive to the offensive, modernizing other parts of the plant power system to remove possible sources of trouble. And management is backing them fully, knowing that the cost of a modern power equipment is a low premium to pay for long-term insurance against production stoppages and possible injury to personnel.

Do you have adequate insurance against short circuits, power failure, loss of production? If not, you'll be pleased to find how easily and economically you can be "covered." You can install G-E factory-assembled load-center unit substations with metal-enclosed switchgear, either in stages or all at once for a modern, reliable load-center distribution system. Your G-E sales representative is ready to plan it with you. Apparatus Dept., General Electric Company, Schenectady 5, N.Y.

GENERAL ELECTRIC

lines used for winding heavier are rated 2 hp., 1,150/2,300 rpm. 230 volts, d.c. The swift motor, which normally functions as a drag generator, is normally rated from one-fourth to one-third the rating of the bobbin motor. The wire leaves the swift at an almost constant unwinding radius. That is, the loose wire coil is thrown on the swift in such a manner that the inner wrap of the coil is "peeled" off the swift at the bottom inside "corner" of the swift core at a linear wire speed directly proportional to the swift rpm. The generator is loaded on an adjustable braking resistor. Thus, the swift generator controls wire tension and indicates wire speed.

The new electronic equipment, manufactured by General Electric Co., regulates the speed of the bobbin motor, making it possible not only to operate at higher wire speeds than were formerly used, but to hold wire speed constant throughout the full bobbin build-up. The new controls are mounted directly above each of the lines, which are side by side and parallel to each other. This arrangement has effected a 50 percent saving in floor space over the previous group drives. Another advantage of the new equipment is that wire is wound more tightly and uniformly, with more wire per bobbin and fewer breaks. Moreover, limit switches stop each line when the end of the wire leaves the swift and thus relieve operators for other duties. In addition, mechanical maintenance costs have been materially reduced.

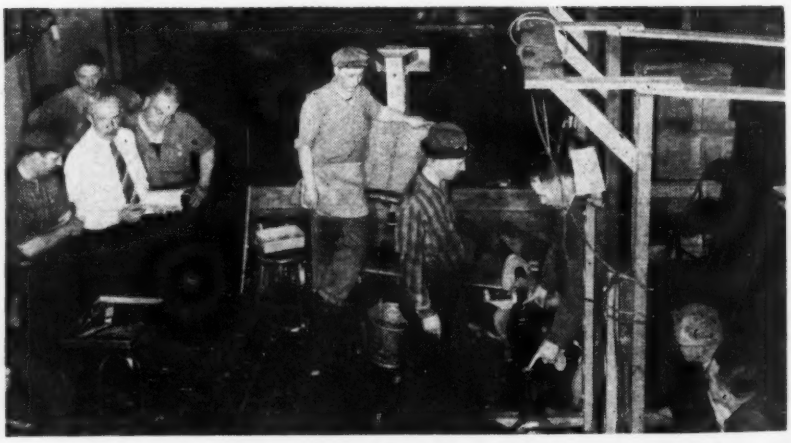


ARRANGEMENT of typical Thy-mo-trol wire rewinding equipment

• • •

Cable Splicing School at Boston Edison

To INSURE proper progress and quality of work in the installation of Boston Edison's new 110-kv. Mystic-Woburn oil-filled cable, a special school for jointing procedure was established at the company's general service buildings under the direction of the joint manufacturers. The training course ran from six to seven weeks, and about 35 men were given practical instruction in splicing both stop and normal joints, the training also including the teaching of supervisors, inspectors, degasifier crews and other personnel in the techniques required. A skeleton or dummy manhole was built full size as to layout and racking arrangements, with cable bent exactly as required in the field and kept under oil pressure by reservoirs during splicing work. The racking arrangements were flexible as to height and spacing, as shown, and full provision was made for inspecting the work and testing the quality of joints. The work was done indoors.



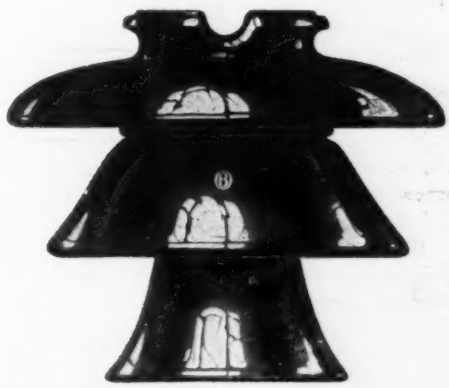
CABLE SPLICER'S SCHOOL AT WORK in skeleton manhole

CLOSE-UP of typical stop joint and full-sized cable bends in skeleton manhole

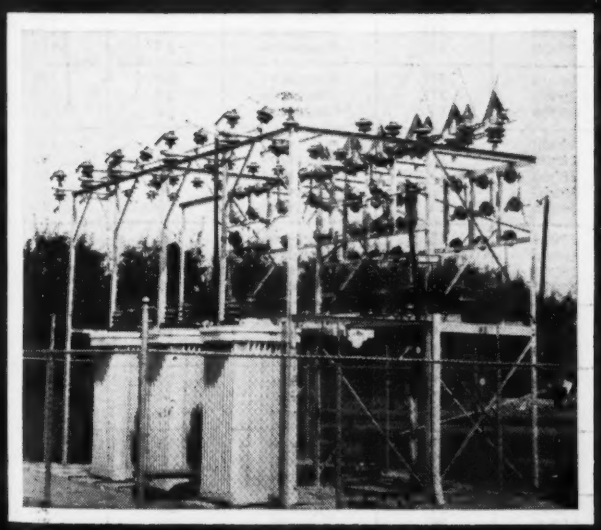
COMES A TIME

How GOOD IT IS!

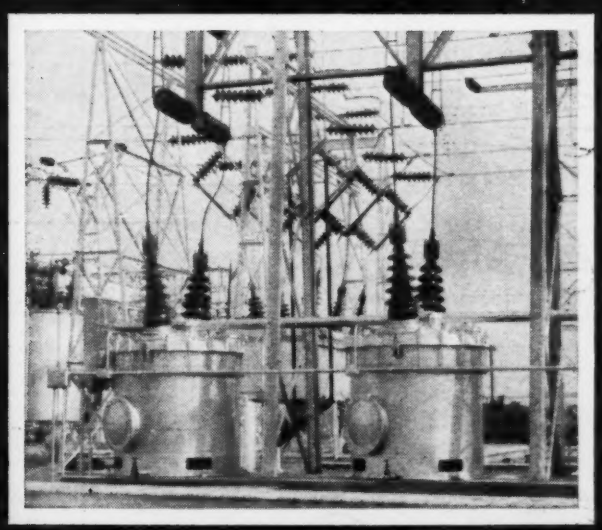
Thirty years ago, this shotgun looked just like any other--*in a show case.* The man who bought it was justified in asking, "How good is it?". But after years of faultless service, this question has been forgotten. *He knows!* . . . Insulators in a catalog or on a stock shelf are in their "show-case" until requisitioned for construction. They look alike, test alike, specify alike--*are* pretty much alike the day they go on the line. But, years of service tell a different story. They are anything but alike a generation later. . . Years ago, experienced men selected the O-B insulators shown in these pictures. They may once have asked "How good are they?", but that question has long since been forgotten. *Now they know!*



2659-H



Twenty-six years ago, O-B switch and bus insulators were put in service on this small substation and have yet to require any attention.



These O-B oil-filled bushings are rounding out their twentieth year in service on heavy 110-Kv. breakers. Their present record gives no indication of ultimate service life.

Basic Street Lighting Design*

DESIRED ILLUMINATION is determined according to pedestrian and vehicular traffic from Table I. This is modified by such correction factors as may be appropriate for pavement reflectance and for maintenance to arrive at initial foot-candles value. The foot-candle values in the first column of Table II are then consulted for typical recommendations. The spacings in Table II are approximate and where existing pole lines are utilized it may be necessary to use a different lamp size to compensate for departures from recommended spacings.

The diagrams of light distributions of typical luminaires are of the 75-deg. cone. They follow the usual convention of designating the direction across the street as 0 deg., parallel with the street as 90 deg., and directly back from the street as 180 deg.

Type I—Two-way distribution. Intended for mounting approximately over the center of the street.

Type II—Narrow asymmetric distribution. Intended for mounting at or near the side of the street.

Type III—Medium-width asymmetric distribution. Intended for mounting at or near the side of wide streets.

Type IV—Wide asymmetric distribution. For mounting at street side on spacing closer than Types II and III.

Type V—Symmetric distribution. Useful for installation in center parkways, and at intersections to some extent.

LIGHT DISTRIBUTION

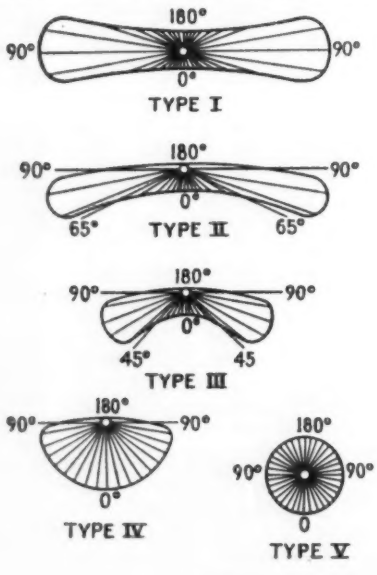


Table I

Recommended Average Horizontal Foot-candles (Lumens per square foot) for Urban Streets

Pedestrian Traffic	Vehicular Traffic—Vehicles per Hour			
	Very Light (under 150)	Light (150–200)	Medium (500–1,200)	Heavy to Heaviest (1,200 up)
Heavy	*	0.8	1.0	1.2
Medium	*	0.6	0.8	1.0
Light or None	0.2	0.4	0.6	0.8

** An unusual condition. If it should exist, the foot-candle figures in the column to the right may be used.*

Table II

Typical Arrangement of Luminaires, Mounting Height and Spacing for Various Initial Foot-candle Values

Foot-candles	Street Width (Feet)	Lamp Lumens	Type Distribution	Luminaire Arrangement	Mounting Height	Approximate Spacing (Feet)
0.2	30	2500	I	Center	25	170
	30	2500	II	Staggered	20	165
	30	4000	I	Center	25	200
	40	4000	II	Staggered	25	200
	40	4000	III	Staggered	25	200
0.3	30	4000	I	Center	25	180
	30	4000	II	Staggered	25	150
	40	6000	II	Staggered	25	210
	40	6000	III	Staggered	25	210
0.4	40	6000	II	Staggered	25	155
	50	6000	II	Staggered	25	135
	50	6000	III	Staggered	25	140
	50	6000	IV	Staggered	25	110
0.5	40	6000	II	Staggered	25	125
	50	6000	II	Staggered	25	110
	50	6000	III	Staggered	25	110
	50	6000	IV	Staggered	25	90
0.6	50	10000	III	Staggered	30	140
	60	10000	III	Staggered	30	125
	60	10000	IV	Staggered	25	115
0.7	50	10000	III	Staggered	30	120
	60	10000	III	Staggered	30	110
	60	10000	IV	Staggered	25	95
0.8	50	10000	III	Staggered	30	105
	60	10000	III	Staggered	30	95
	60	10000	IV	Staggered	25	85
	70	10000	III	Staggered	30	85
	70	10000	IV	Staggered	25	75
1.0	60	10000	III	Staggered	30	75
	60	10000	IV	Staggered	25	70
	70	10000	IV	Opposite	25	120
	80	10000	IV	Opposite	25	110
1.2	60	15000	IV	Staggered	30	75
	70	15000	IV	Opposite	30	130
	80	15000	IV	Opposite	30	120
1.4	60	15000	IV	Opposite	30	120
	70	15000	IV	Opposite	30	110
	80	15000	IV	Opposite	30	100
1.6	60	15000	IV	Opposite	30	105
	70	15000	IV	Opposite	30	95
	80	15000	IV	Opposite	30	90
1.8	60	15000	IV	Opposite	30	95
	70	15000	IV	Opposite	30	85
	80	15000	IV	Opposite	30	80
2.0	60	15000	IV	Opposite	30	85
	70	15000	IV	Opposite	30	75
	80	15000	IV	Opposite	30	70

*Summarized from "Recommended Practice of Street and Highway Lighting," Illuminating Engineering Society.

NEW EDITION OF FIBERGLAS ELECTRICAL INSULATION MATERIALS CATALOG

Just off the Press

Anyone concerned with insulation for electrical, radio, electronic or video applications can use the Fiberglas Electrical Insulation Materials Catalog to advantage.

It contains complete information about the many forms of Fiberglas Electrical Insulation Materials. Indicates where and how to use this material to obtain its many advantages.

It describes the unique combination of electrically and mechanically important characteristics of Fiberglas, such as: resistance to high temperature, moisture and acid; favorable space factor and high tensile strength. It shows how the insulating impregnants increase the effectiveness of Fiberglas' inherent characteristics and add others such as high dielectric strength, insulation resistance and resistance to abrasion.

You will see why the use of this basic, inorganic, insulating material is increasing so rapidly—*why the swing is to Fiberglas.*

Be sure to have a copy of this new booklet in your file for ready reference. Write for copy today —there is no obligation. Owens-Corning Fiberglas Corporation, Dept. 858, Toledo 1, Ohio.

In Canada, Fiberglas Canada Ltd., Toronto, Ontario.

OWENS-CORNING

FIBERGLAS

REG. U.S. PAT. OFF.

Pole Replacement Tables Yield Minimum Ground Line Circumference—I

E. S. JACKSON, Electric Distribution Department, Consumers Power Co., Jackson, Mich.

System of tables permits rapid field determination of minimum allowable ground line circumference of poles at replacement for Grade C (or B) construction. Pole loading is expressed in terms of "wire equivalents." Tables are used by Consumers Power Co. to guide pole treatment program. Summation tables will be presented in a subsequent issue.

How to Use the Tables

To determine the minimum allowable ground line circumference of a specific pole, using the accompanying tables, proceed as follows:

1. Count number wires and guys on pole at primary levels along the heaviest lead.
2. Enter Table I at left with this number. Under "primary" read wire equivalent corresponding to proper pole height.
3. Count number wires and guys on pole at secondary levels.
4. From Table I find corresponding wire equivalent under "secondary" corresponding to proper pole height, as in (2) above.
5. Add wire equivalents found under (2) and (4). To the sum add; 1 for each telephone twisted pair, 3 for each telephone cable and 1 for each three No. 4/0 conductors.
6. Find total in left column of Table II or III, for Western Red Cedar or Northern White Cedar, and under the proper average span length read required ground line circumference of pole for Grade C construction. For Grade B construction multiply circumference from table by 1.26. (Tables II and III will be published in an ensuing issue.)

Special Situations

For each transformer of 25 kva. or less on a pole add ½ in. to circumference found in (6). For transformers over 25 kva. add 1½ in. If transformers are supported between two poles, increase circumference of each pole an amount corresponding to half the total kva. of the transformer bank. If a wire exists in only one of the two spans, it shall have only half value.

Basic Assumptions

Wire equivalents of Table I are, in effect, the bending moment per foot of span due to ½-in. ice and 4-lb. wind divided by 10 and rounded off. In making up the table, wire sizes were assumed to be No. 1/0, 3 or 6, as follows: Up to three complete three-phase primary circuits wires were assumed as No. 1/0; a fourth complete circuit was considered No. 3 while wires not forming a complete three-wire circuit were considered as No. 6. Thus 14 primary wires would be assumed to be nine No. 1/0, three No. 3 and two No. 6. In secondary circuits the first complete group of three wires was considered as two No. 1/0 and No. 3; six secondary wires were assumed as three No. 1/0 and three No. 3. All wires over six were assumed as No. 6.

Spacings are on the basis of 3 ft. per gain primary (top circuit in top gain) and 2 ft. per gain for secondaries; the range is from 20 to 31 ft. depending on pole height.

Tables II and III are based on a replacement resisting moment which, according to the National Safety Code, permits stressing a pole in Grade C construction to 75 percent of ultimate strength. Wind on the pole has been subtracted from the resisting moment. Circumference thus indicated is one capable of supporting both wind and wire load on the pole. In doing this, wind on a 30-ft. pole was subtracted up to 22½-in. circumference; on a 35-ft. pole to 27½ in. etc., grouping poles on an A.S.A. basis of height and circumference. By plotting a curve of bending moment per foot of span vs. span length, necessary resisting-moment was picked off and translated in terms of circumference.

Table I—Wire Equivalents

No. Wires on Poles at Levels	Pole Length in Feet										
	Secondary and Telephone				Primary						
	25	30	35	40–60	35	40	45	50	55	60	65
1	1	1	1	1	1	1	2	2	2	2	2
2	2	2	2	3	2	3	3	4	4	4	5
3	3	4	4	5	4	5	6	7	7	8	9
4	4	5	5	6	6	7	7	8	9	10	11
5	5	6	6	7	7	8	9	10	11	12	13
6	6	7	8	9	8	10	11	13	14	16	17
7	7	8	9	10	9	11	12	14	16	18	19
8	7	9	10	12	10	12	14	16	18	19	21
9	8	10	11	13	12	14	16	19	21	23	25
10	9	11	11	14	13	16	18	20	22	25	27
11	9	12	12	15	14	17	19	22	24	27	29
12	10	13	13	16	15	19	21	24	27	30	32
13	11	13	14	17	16	20	22	25	28	31	34
14	11	14	15	18	17	21	24	27	30	33	36
15	12	15	16	19	18	22	25	28	32	35	38
16	12	16	17	20	19	22	26	30	33	37	40
17	13	17	18	21	20	23	27	31	35	38	42
18	14	18	19	22	21	24	28	32	37	40	44

TO GIVE YOU TOP PERFORMANCE

Quality is Controlled STEP by STEP

ROMEY SAYS—

"Our inspection personnel are mighty proud of the quality contribution made to Rome Cable utility products through their rigid inspection standards."

The exacting requirements of the electrical utility industry demand that its suppliers exercise the utmost in quality control. Quality Control in the finished article is achieved in Rome Cable products by vigilant inspection during all stages of manufacture. Standards of quality at Rome Cable are the responsibility of a highly experienced and adequately staffed inspection division which functions independently of the production and sales departments, is responsible only to the president, and concerns itself with only one objective—Quality Control. Thus close and exacting quality surveillance is never influenced by pressure for production increases.

FROM BAR TO FINISHED WIRE

ROME CABLE CORPORATION

ROME • NEW YORK

How TVA Installs a Pole On An Engerized Line

W. L. WAGES, Chief, Transmission System Maintenance Staff, Tennessee Valley Authority, Chattanooga, Tenn.

Sequence of operations is illustrated for the installation of a pole in a span on a 44-kv. line with pin-type insulators. Work on energized lines is performed with live line tools thus avoiding necessity of interruptions to service.

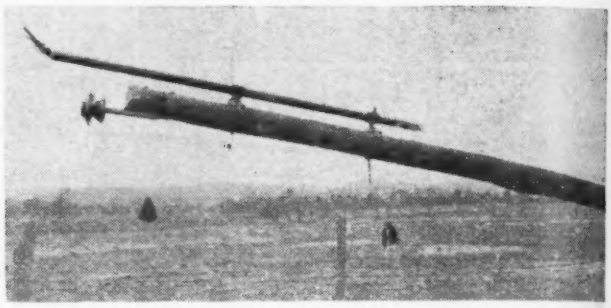


FIG. 1—Pole to be erected is capped, a pin-type insulator attached, and a ridge pin lift pole clamped on to raise the center line conductor

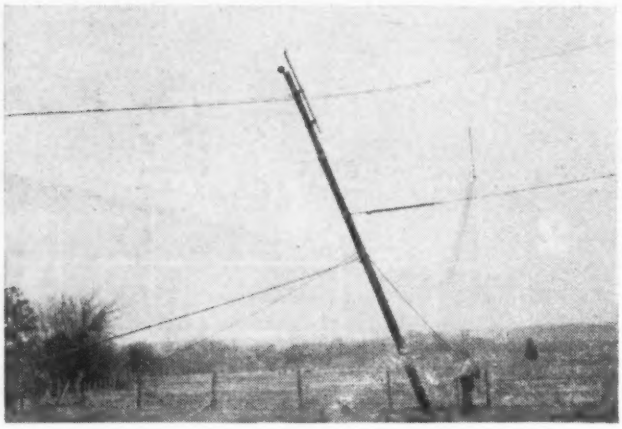


FIG. 2—Pole is about to drop in the hole, having been guided by side guy lines while being pulled up by a line to a truck winch. Two lower conductors have been spread by individual roller link sticks and rope lines

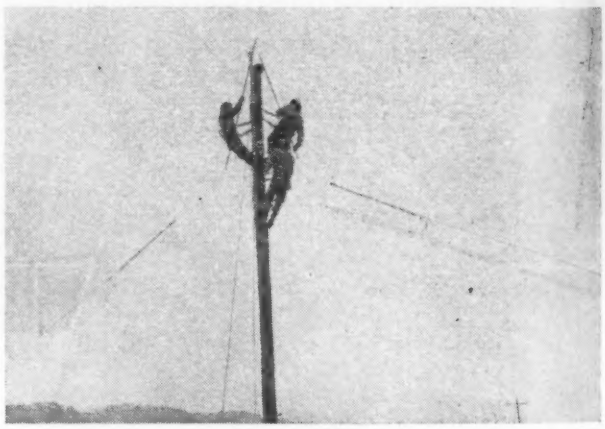


FIG. 3—Top center conductor has been lowered from the ridge pin lift pole to insulator with tie wire by use of a tie stick. The lift pole will be removed, then crossarm will be hoisted and attached

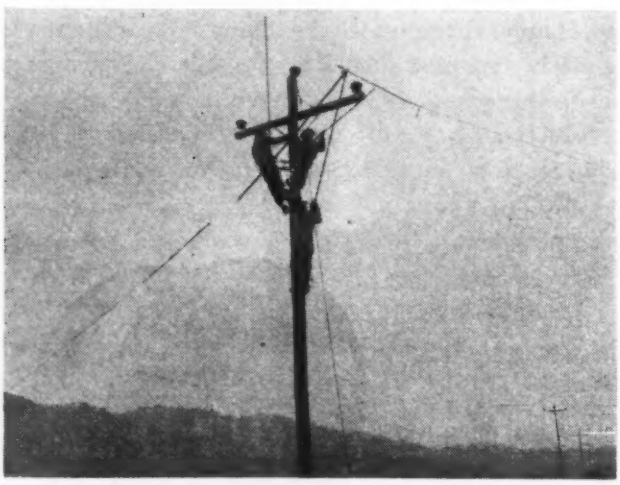


FIG. 4—One spread line has been released and the conductor is being fastened to the pin insulator

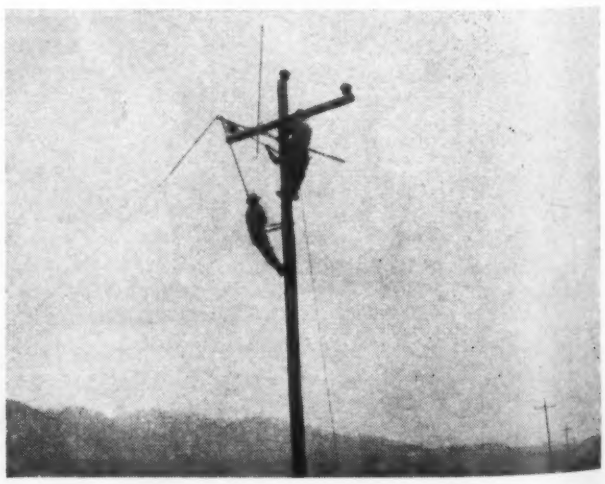
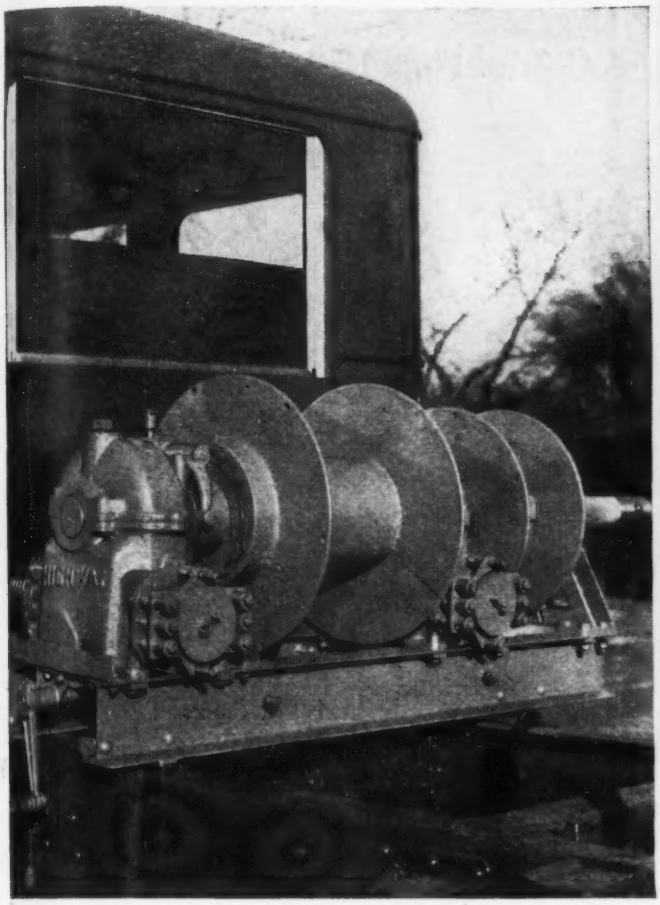
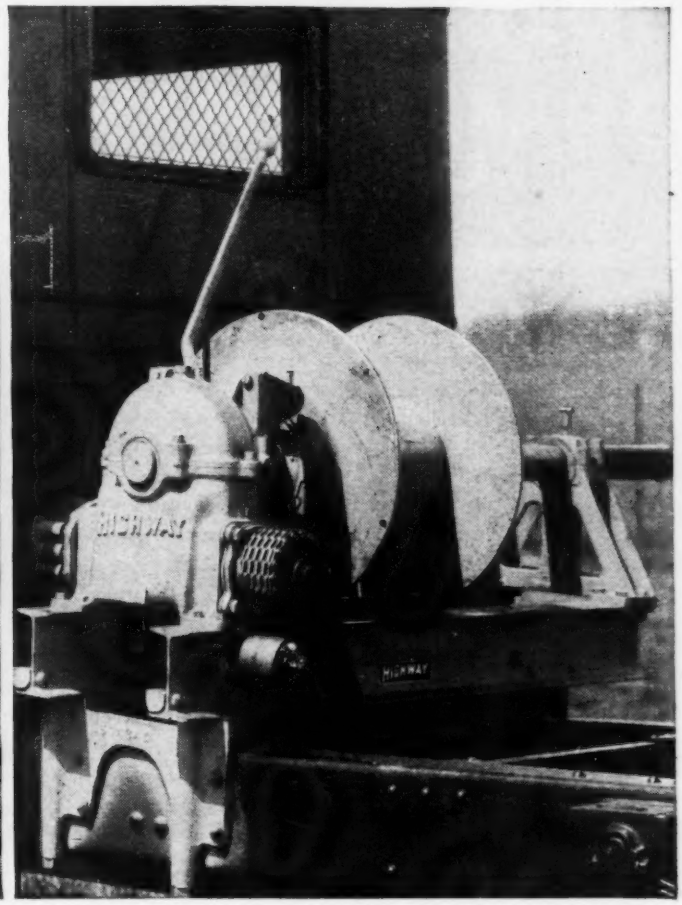


FIG. 5—Conductor on opposite side of pole has been released and is being fastened by a tie stick



HIGHWAY MODEL L-12c-6 Double Drum Winch is a dual-purpose unit. 12" drum has spline type clutch. 6" drum is fixed type.



HIGHWAY MODEL L-12c Winch is a small compact unit specially designed for use on 1½ and 2-ton truck chassis.

Maximum safety for operators in strong, rugged HIGHWAY winches

There's a big extra measure of personal safety for operators in Highway Winches and power Take-offs —built with extra strength and ruggedness to stand up under emergencies as well as routine operating conditions. Compactness, dependability, efficiency are features which have made Highway Winches famous from coast to coast.

Whether you choose the Highway Model L-12c-6 Double Drum Winch or the new compact Model L-12c, you'll get the smooth operation, the uncompromising integrity which have built Highway's reputation for plus value.

Highway Line Construction and Maintenance Bodies, Earth Boring Machines, Pole Trailers and Cable Reel Trailers deserve all the good things you have heard said about them. Write us today about your own special requirements.

HIGHWAY TRAILER COMPANY

Manufacturers of: Utility Bodies • Winches • Earth Boring Machines • Pole and Cable Reel Trailers and other Public Utility Equipment.

General Offices: **EDGERTON, WISCONSIN, U.S.A.**

Portable High-Voltage Cable Test Unit

LOREN H. HUTCHINS, JR.
Assistant Cable Engineer, Simplex Wire & Cable Co. Cambridge, Mass.

ALL insulated wire passing through this company's factory undergoes one or more high-voltage tests. With thin-wall, extra low-voltage wires the check-up may take the form of an a.c. "spark" test, which is reasonably severe but relatively short. All wires rated for circuits of 110 volts and over are given a so-called "punch," or standard high-voltage test after every process in manufacture, in order to discover possible damage to conductors while in machines or in transit. The need of equipment to test wire of all sizes and types with speed, accuracy and, above all, safety led to the development and construction of a so-called "Punchmobile," or portable, high-voltage d.c. test control unit.

The "Punchmobile" is essentially a portable panel carrying the apparatus required to control the application of d.c. voltage from one of a number of strategically located testing stations. It does not contain all the equipment for such tests. Rectifier tubes, a "hi-pot" transformer, filament transformers and their immediate controls are not included, but are fixed at a convenient central location. The high voltage is supplied from a generator by cable and bus structure to the point where the operator is located with his control set and where he can at all times observe wire under test. A control cable and terminal connector are located at each of the several stations where tests are to be made, circuits to the control set being completed by plugging into a female connector on top of the unit. No high-voltage circuit passes through the set. Where failure of any element might cause such a condition, protective devices are employed.

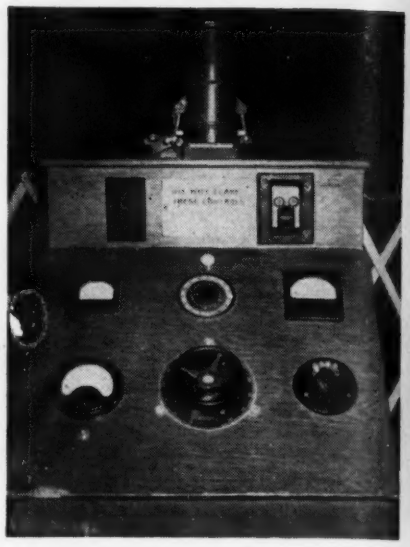


FIG. 1 — Operating panel of "Punchmobile" test-control unit

Fig. 1 shows at rear right an air circuit breaker that functions when failure of insulation occurs. Winding of the 0-100-kv. voltmeter is such that 100 microamperes produces full-scale deflection. At top center is a timer; most tests are of five minutes' duration, but occasionally other periods are used. Below the timer is a 2-kva. auto-transformer that controls the input to the high-voltage transformer.

Fig. 2 is a schematic diagram of the entire testing circuit, and shows the position that the "Punchmobile" occupies therein. As now arranged, the rectifier tubes are each rated 150 kv. peak inverse voltage, and the main transformer 125 kv. rms. The high-voltage selector brings a circuit to each testing station that can only be closed by a corresponding shorting plug at the high-voltage bus. An additional safety feature, but which is never solely relied upon, is a grounding bar actuated by a solenoid; when its coil is deenergized, the bar grounds the high-voltage lead.

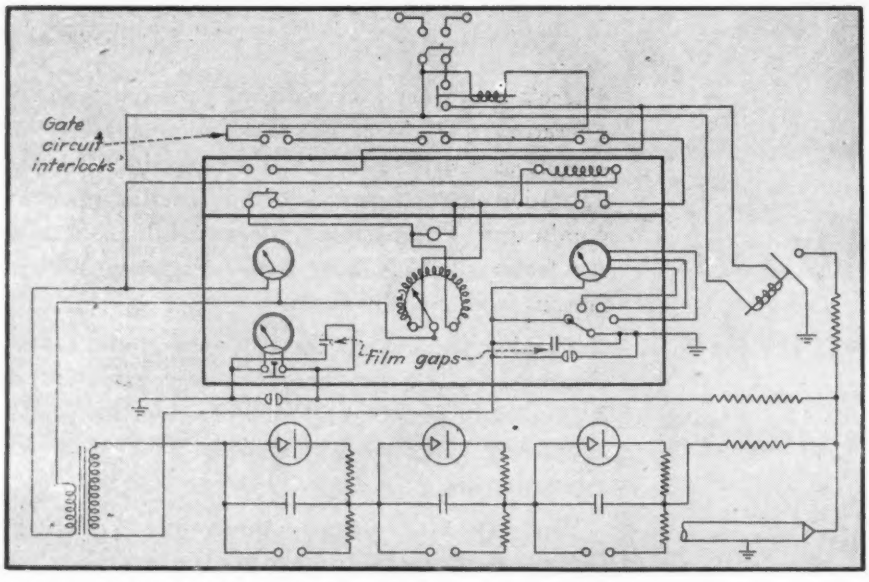


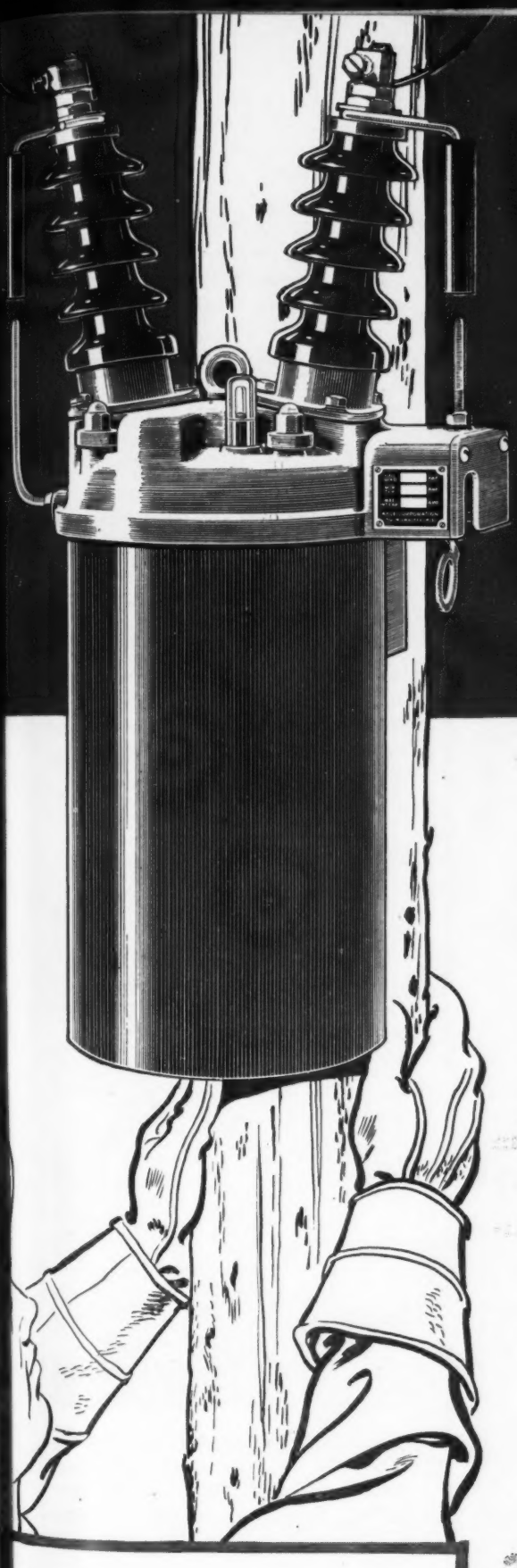
FIG. 2—Schematic diagram of complete testing facilities

• • •

"Fireproofing" Power Cables in Groups

GROUPED power cables in ducts above or below switchboards and in large junction boxes may be a source of serious service interruption unless fireproofed according to modern practice. In one typical case, fire caused by arcing involved 40 cables in a trench behind the switchboard, all being destroyed with a resulting industrial plant shutdown of several days, $4,000 direct damage and $10,000 loss in use and occupancy categories. In another case, power was supplied to two factories by twelve cables passing through a single junction box. Arcing at one cable quickly involved the others, and their insulation was completely destroyed. Total damage was $12,000.

Insurance engineers investigating these fires recommended for new wiring and replacement work single-conductor, rubber-insulated cable for 600 volts or less, provided with a flame-



KYLE OIL CIRCUIT RECLOSERS ARE SAFE 3 WAYS

TO GIVE GREATER PROTECTION TO THE LINEMAN

The Kyle Type "H" Oil Circuit Recloser gives greater protection to the lineman, greater protection to the recloser, and thereby greater protection to your lines and service.

Protection of the lineman is provided by these triple-safe features:

1. **The Head of the Recloser is dead.** The entire top, consisting of the operating handle and cover, contain no live surfaces. The two line terminals are the only "hot" spots.

2. **The Operating Handle is dead.** The operating mechanism is trip-free of the handle. It is impossible for a blow from the mechanism to be imparted to the operator.

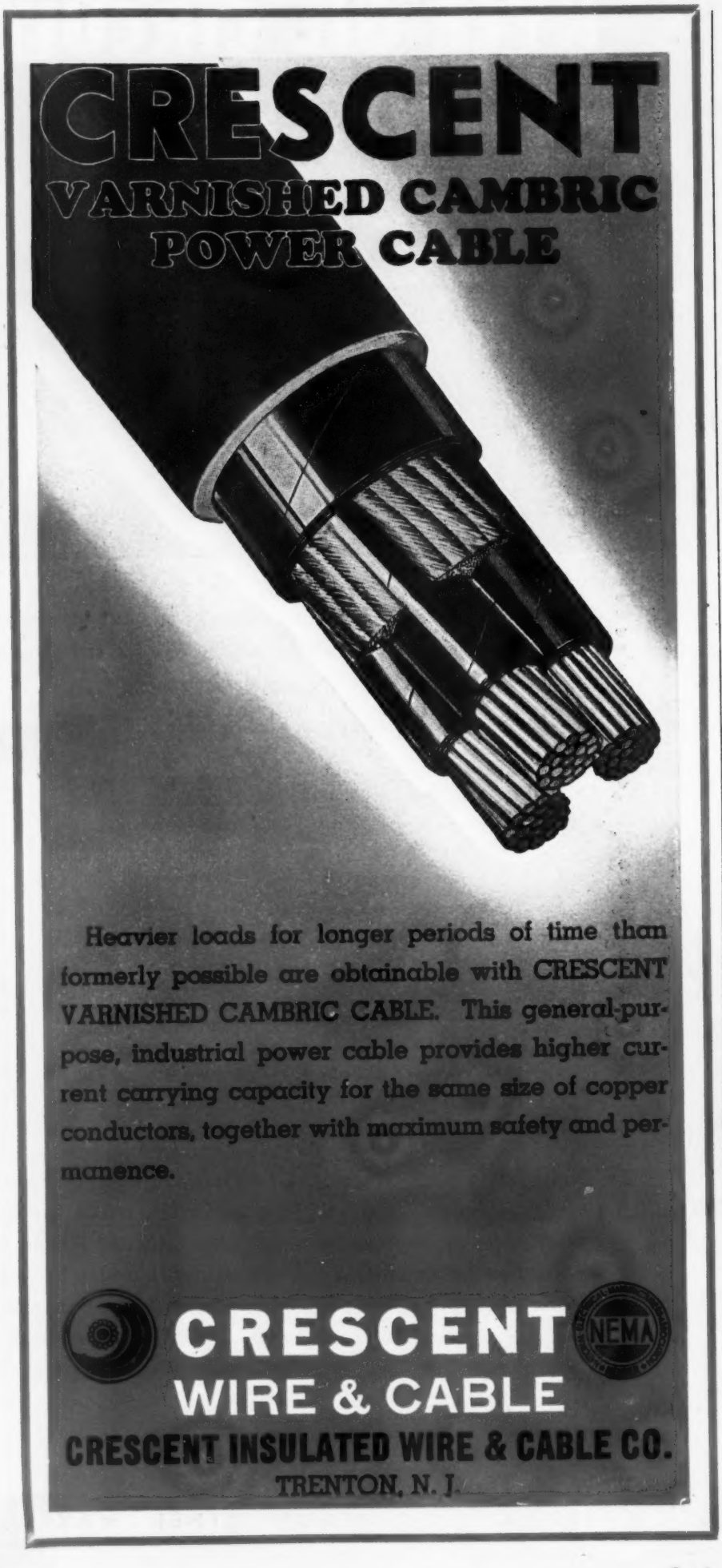
3. **The Tank is dead.** There are no live surfaces on the tank. It is entirely dead and provision is made for grounding. Except for the lead-in bushings AT THE TOP, the entire recloser is dead.

Damage to the recloser from continued overheating under severe overload is impossible with the Kyle Oil Circuit Recloser. A thermo-trip device will automatically lock-out the recloser. Heating is reduced by the use of large coil wire which reduces the IR drop through the recloser. Heat is carried away rapidly by the metal tank. The normal position of the Kyle Oil Circuit Recloser is the safe, open, position. Any mechanical failure opens the recloser. This prevents accidental reclosure and insures complete protection to anyone working on the line.

Ask your Line Material Representative for full information on Kyle Type "H" Oil Circuit Reclosers. Let him show you how they will improve your service to customers . . . earn more revenue for you.

MADE BY KYLE CORPORATION SOUTH MILWAUKEE WISCONSIN

KYLE Circuit Reclosers are Designed and Manufactured by LINE MATERIAL COMPANY


CRESCENT
VARNISHED CAMBRIC
POWER CABLE
Heavier loads for longer periods of time than formerly possible are obtainable with CRESCENT VARNISHED CAMBRIC CABLE. This general-purpose, industrial power cable provides higher current carrying capacity for the same size of copper conductors, together with maximum safety and permanence.
CRESCENT
NEMA
WIRE & CABLE
CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, N. J.

resisting outer cover. It was pointed out that an accepted method of flameproofing cables not so protected is to wrap each cable with asbestos tape applied with a 50 percent lap, and then thoroughly saturate the covering with a thin solution (specific gravity 1.5) of silicate of soda. The asbestos tape should be at least 1/16 in. thick for conductors up to No. 0, and ⅛ in. thick for larger sizes. Asbestos outer coverings should not extend directly to bare live conductors at the end of the wire, but should terminate about 3 in. from the bare parts to prevent leakage over the outer covering. Wrapping of this kind will not prevent arcing, and some fire may occur at the arc; but the wrapping on adjoining cables prevents fire spreading and confines interruptions to one or two cables. Non-combustible coverings are strongly advised for new elevator cables, since fireproofing by wrapping is impracticable in this application of electrical service.

Meter Sockets Identified To Reduce Losses

R. J. McKNIGHT
Central Arizona Light & Power Co.
Phoenix

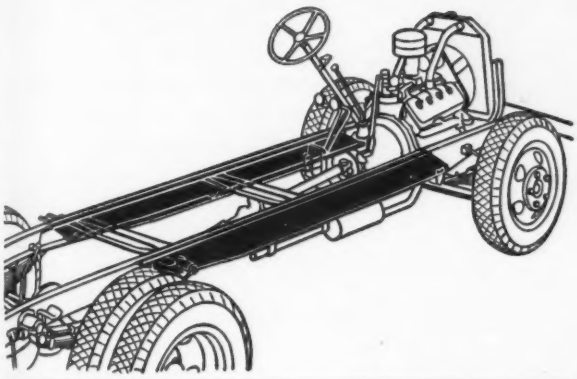
STAMPING meter bases serially and with company identification reduces unaccounted-for losses where utility furnishes sockets. Flange of base rests on iron pipe ring while being stamped

To avoid the accounting difficulties experienced by many utilities who furnish meter sockets to wiremen for installation, the Central Arizona Light & Power Co. follows the practice of serially numbering each socket and stamping the company name on the face of the flange. Sockets delivered

REGISTRATIONS *SHOW* IT — OPERATORS *KNOW* IT!

"FORD TRUCKS LAST LONGER!"

One big reason—
FORD FRAMES STAND UP!



One of the big reasons why 78 per cent of all Ford V-8 Trucks ever built are still in use, is found in Ford frame engineering. Ford Light Duty Half-Ton units, for instance, have true *truck* frames—parallel side-rails—full SAE 34-inch width, taking standard bodies—rear kick-up and side-mounted springs for extra-low load height—alligator jaw cross-member—great strength and rigidity, for longer life to cab and body. The full-channel side-rails of Heavy Duty frames are *doubled* between springs, as illustrated, increasing side-rail strength 46 per cent—a construction far superior to old-fashioned fishplates.

Ford

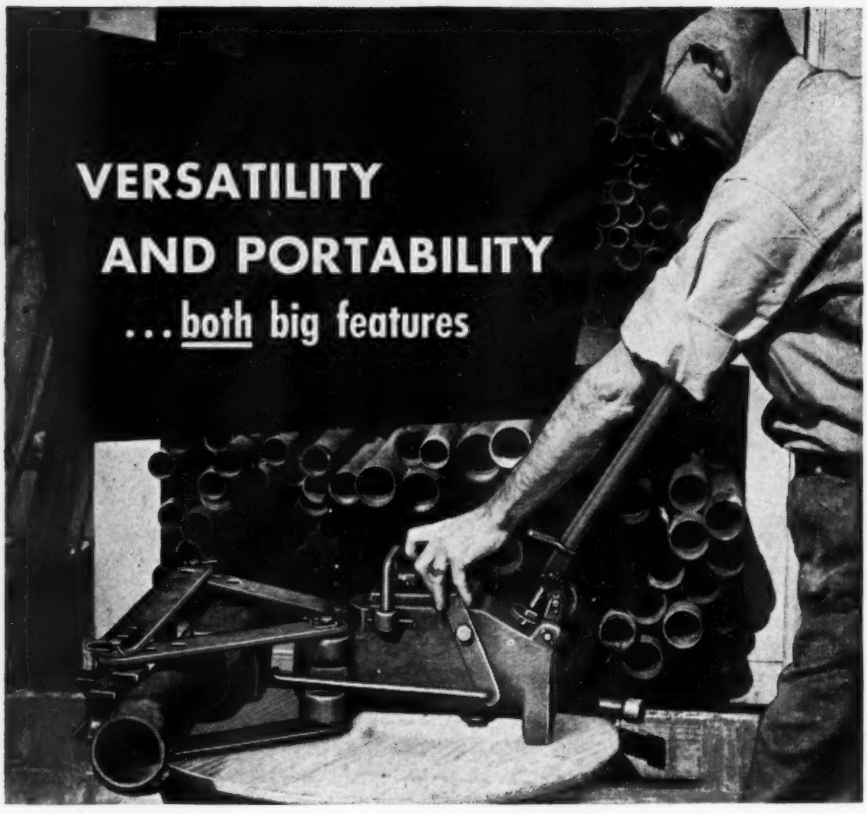
Ford Half-Ton with 6½-foot clear-floor Pickup body.

Only Ford offers all these long-life features: choice of 2 great engines, the 100-H.P. V-8 or the 90-H.P. Six—Flightlight aluminum alloy, 4-ring pistons—short, rigid, fully counter-balanced cast alloy steel crankshaft—big brakes, with non-warping, score-resistant cast drum surfaces—extra heavy sheet steel in fenders, hood, cowl and cab—4-pinion differential with triple roller bearing, straddle-mounted axle drive pinion.

There are *more than fifty* such examples of Ford endurance-engineering in today's Ford Truck. NO OTHER TRUCK BRINGS YOU ALL THESE IMPORTANT EXTRA VALUES AT ANY PRICE. Each one adds to the years of faithful service you can confidently expect from your Ford Truck. Let your Ford Dealer point them out to you.

FORD TRUCKS

MORE FORD TRUCKS IN USE TODAY THAN ANY OTHER MAKE



GREENLEE HYDRAULIC BENDER

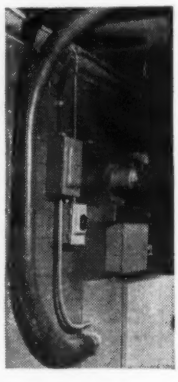
Whether you are installing rigid or *thin-wall* conduit, pipe up to 4½", tubing or bus-bars, you'll find the GREENLEE Hydraulic Bender a great time and materials saver!

With a GREENLEE *one man* easily and quickly makes smooth, precise bends *right on the job* . . . when and where needed!

For example, F. M. Powell, Manager of Powell Electric Co., Montgomery, Alabama, has this to say. "The GREENLEE can be set up on a table, floor, or even on the ground and pays for itself in less than a dozen jobs.

"Specifically, on a ten foot section of 3½" conduit with two 90° bends in different planes (illustrated at right), we saved $9.00 for fittings, not counting the labor of cutting and threading joints."

You, too, can make important savings, speed your jobs, produce neater, "easier to fish" conduit installations with a GREENLEE Hydraulic Bender. Get complete information today. Write Greenlee Tool Co., Division of Greenlee Bros. & Co., 1810 Columbia Ave., Rockford, Illinois, U. S. A.



Sales Agents for Canada: Richardson & Bureau, Ltd., 129 St. Peter Street, Montreal.

80th Anniversary
1866-1946

REGISTERED TOOLS
GREENLEE
FOR THE CRAFTSMAN

OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK

Hand Benders • Joist Borers • Cable Pullers • Knockout Tools • Pipe Pushers

to wiremen are listed in a log book which the contractor signs acknowledging receipt. When the company sets a meter the serial number of the socket is checked off in the log and the contractor's record cleared. The company name stamped on the socket provides positive identification since several utilities operate in the general area. Of course, many utilities do not have this accounting problem because they are in the fortunate position of requiring customers to furnish their own meter bases.

•

Operating 230-Volt Capacitors on 460 Volts

R. E. MARBURY
Manager, Capacitor Engineering Sec.
Westinghouse Electric Corp.
East Pittsburgh, Pa.

BANKS of capacitors for power factor correction on 230-volt circuits often consist of assemblies of 230-volt, 3-phase units in metal racks or cabinets. These 3-phase capacitor units are delta-connected internally with leads brought out through three terminal bushings. In cases where the plant circuits are changed to 460 volts, the problem arises as to whether these 230-volt capacitor banks can be used on 460 volts by reconnection. If the capacitor bank contains single phase units having two terminals, it is a simple matter to reconnect them

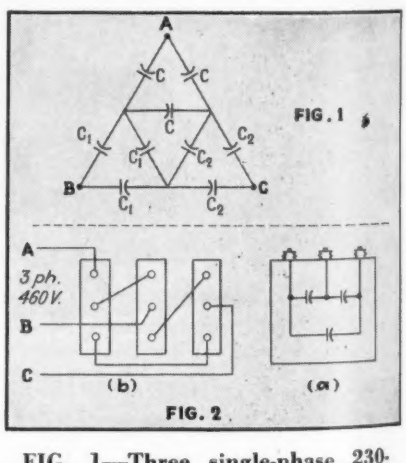


FIG. 1—Three single-phase 230-volt 3-phase capacitors arranged for use on 460-volts 3-phase

FIG. 2—Connections of 3-phase 230-volt capacitors for feasible use on 460-volt systems: (a) Internal connections of 230-volt 3-phase unit. (b) External connections for 460-volt 3-phase service

High Resistance to Heat, Flame, Corrosive Fumes and Moisture

Wrapped up in a Flexible Conduit

A TYPICAL ROCKBESTOS CONSTRUCTION DESIGNED TO GIVE LASTING SERVICE

The Rockbestos A.V.C. Power and Control Cable illustrated is one of many constructions designed to give failure-free performance in power and control circuits. They are also made with either lead sheath or armor coverings or asbestos braids in voltages up to 5000 with individuals insulated like this:

1. Color-coded cotton braid for circuit identification.
2. Heat, flame and moisture-resistant impregnated felted asbestos insulation that won't bake out, crack, flow or rot.
3. Asbestos-protected varnished cambric for high dielectric strength and added moisture resistance.
4. Inner wall of impregnated felted asbestos that won't bake brittle or burn under conductor-heating overloads.
5. Conductors are perfectly and permanently centered in helically applied non-flowing insulation that provides greater current carrying capacity.

One of 125 different constructions designed by Rockbestos for severe or unusual operating conditions.

Here's a Rockbestos A.V.C. cable that not only protects circuits from failing under heat and moisture and other severe operating conditions — but also increases the flexibility of your wiring systems and makes circuits more easily accessible.

Its impregnated *asbestos insulation* withstands heat, corrosive fumes, aging and conductor-heating overloads. The lead sheath protects it from condensation resulting from heating and cooling cycles, and even from immersion. The spiral bronze armor also eliminates the need for conduit, especially important in capacity expansion programs because the cable may be run in troughs, up vertical risers, over and around obstructions.

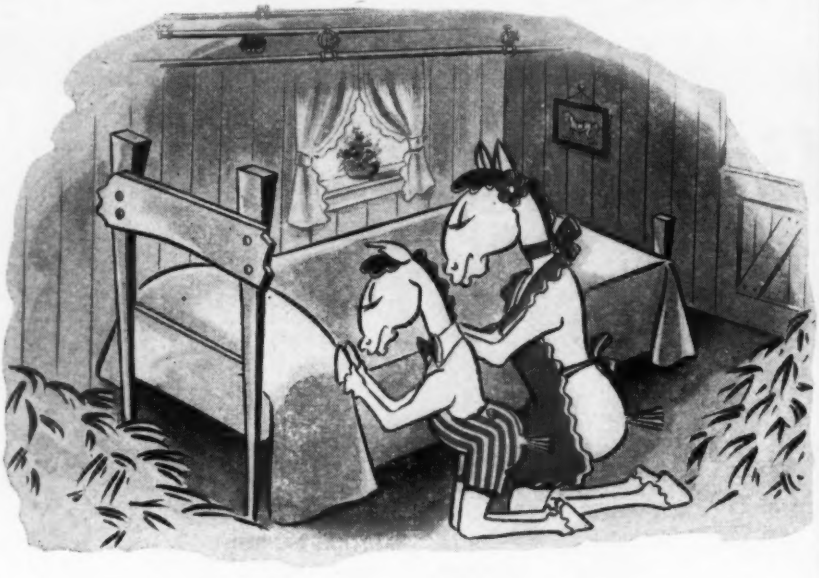
Made in power and control constructions this cable protects operations and reduces maintenance expense. Other failure-preventing Rockbestos A.V.C. constructions are described in the No. 10-E catalog. Write for your copy.

ROCKBESTOS PRODUCTS CORPORATION · 160 Nicoll Street, New Haven 4, Conn.

ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

NEW YORK BUFFALO CLEVELAND CHICAGO
PITTSBURGH ST. LOUIS LOS ANGELES
SEATTLE SAN FRANCISCO PORTLAND, ORE.



We kneel dear Lord in silent prayer,
Ever mindful of Thy guiding care.
We thank Thee Lord as best we're able,
For the "Automatic" Sprinklers
protecting our stable.

Maybe our ode should be entitled "The Horses Entreat" or "The Plugs Plug for "Automatic" Sprinklers."

Definitely certain, however, is the need for proper "fool-proof" fire protection, not only for racing stables, pavilions and the like, but for nearly every type of business establishment.

The tried and proven method of fire protection is the automatic sprinkler.

The tried, proven and entirely "fool-proof" fire protection system is Suprotex*—Rate-of-Rise, the completely "Automatic" System that prevents damage by fire—and water. *It sees and shouts before it fights.*

It will pay you to become acquainted with Suprotex, the best in fire protection. It cost little more, soon pays for itself.

"Automatic" FIRE-FOG
IT BLANKETS IT ISOLATES IT QUENCHES

—a famous member of the "Automatic" Sprinkler Family. Provides adequate protection for quench tank, transformer, oil line and other fires of flammable liquid origin.

* TRADE MARK REGISTERED U. S. PATENT OFFICE.

"Automatic" Sprinkler

"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA

YOUNGSTOWN, OHIO . . . . . OFFICES IN 37 CITIES

"Automatic" Sprinkler designs, manufactures and installs a complete line of fire protection devices and systems for all types of fire hazards. Listed by Underwriters' Laboratories, Inc., and approved by Factory Mutual Laboratories

COPYRIGHTED 1946, "AUTOMATIC" SPRINKLER CORPORATION OF AMERICA

so as to operate in pairs of two units in series, thus getting the full kvar. rating out of each unit. The solution is more difficult with the individual units of the 3-phase delta-connected type because there is no means of making any changes in the inaccessible unit connections.

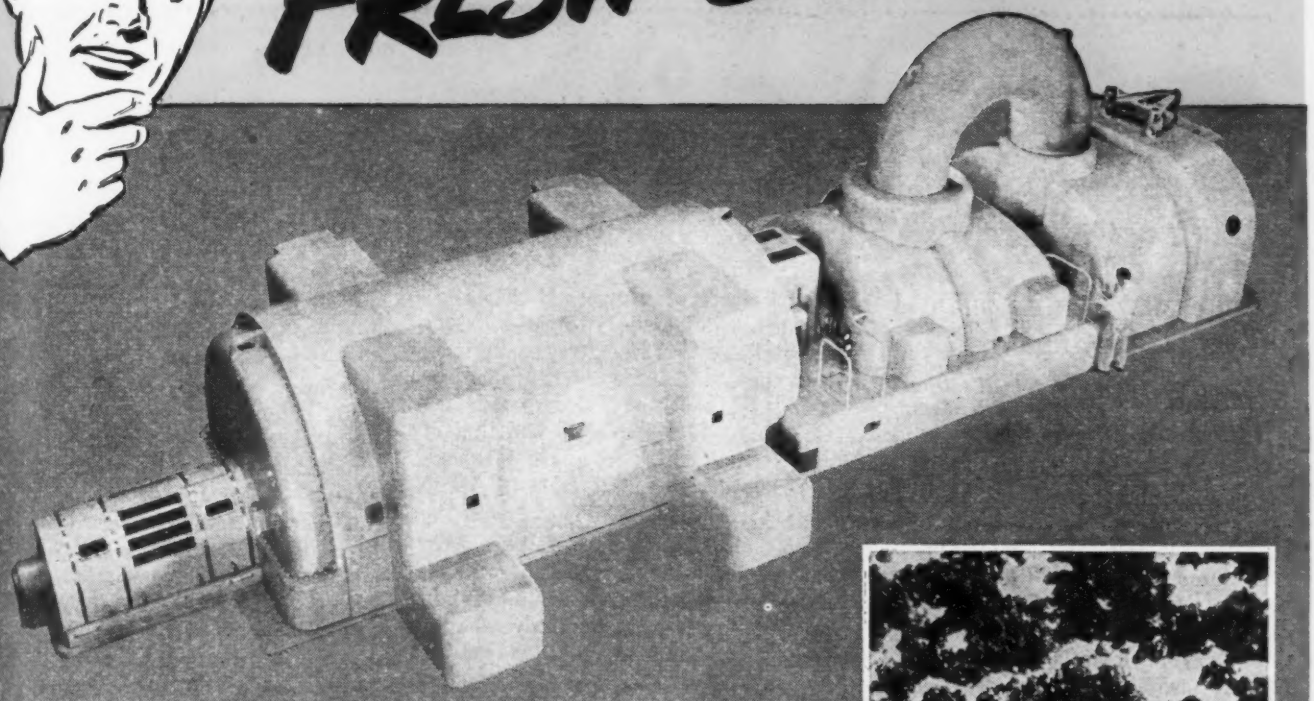
An arrangement that makes it possible to use the 230-volt, 3-phase units on 460-volt, 3-phase consists of connecting them in groups of three as shown in Figs. 1 and 2. Each 3-phase capacitor unit is represented by $C\,C\,C$, $C_1\,C_1\,C_1$ and $C_2\,C_2\,C_2$. The three 460-volt line leads are connected to points A, B and C.

The arrangement does not result in exactly 230 volts on each phase of each capacitor unit. If the three "inside" branches C, C_1 and C_2 of Fig. 1 were present, it is obvious that the voltages would divide equally across $C\,C_1$, $C\,C_2$ and $C_2\,C_1$. Since this is not the case, the net result is a slight elevation of these voltages above normal while the voltages on the third phase of each unit represented by the inside letters $C\,C_2$ and C_1 will be depressed. With 460 volts on the line, the voltages on two phases of each unit will be 243 while on one phase of each unit it will be 92. The kva. of a capacitor changes as the square of the voltage. Therefore, the kva. of the branches or the two phase legs of each capacitor that are boosted to 243 volts is increased above normal, while the third phase of each capacitor unit is severely reduced because these operate at 92 volts. This gives a total of 18 kva. for the three units which are normally $7\frac{1}{2}$ kva. each on 230 volts or 79.4 percent of the full rated capacity.

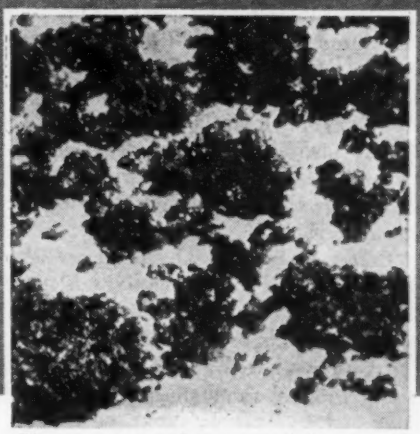
Since capacitor units are designed for use on circuits whose average voltage over any 24-hour period does not exceed 105 percent of the rated voltage, this arrangement may be used when 230-volt units are connected to circuits where the average potential over any 24-hr. period does not exceed 460 volts. The voltage may exceed 460 for short periods by 5 percent and still remain within the short time limit of 110 percent.

The arrangement described therefore makes it possible to use 230-volt 3-phase delta-connected capacitor units on a 460-volt circuit with a sacrifice of one-half of the overvoltage margin of 10 percent, and with much less sacrifice in kva. than would be the case with any other connection.

TIME TO TAKE A FRESH START?



DON'T "INFECT" NEW TURBINE OIL BY PUTTING IT IN A DIRTY SYSTEM!



Photograph of sediment consisting of rust particles, chips of metal, carbon and gum removed from the lube oil system of a large steam turbine. Proper cleaning of a turbine's lube oil system before the initial charge of lubricating oil is installed can save serious trouble.

SHELL CLEANING PROCEDURE

makes it easy—makes it sure!

• A small amount of sludge and dirty oil acts on clean, new oil like a rampaging disease—can shorten its life 50 to 75%. Chemists call it the auto-catalytic effect—sludge, metal particles and rust acting as catalysts to hasten the oxidation of new oil.

Before you add that next batch of make-up oil to your system, be sure to get details about Shell's Turbo Cleaner and the Shell Cleaning Procedure. *You may decide to take a fresh start.*

Remember, too, this procedure should be followed before putting the first charge of oil in *new equipment.* As insurance, it's cheap enough to know that your turbine is free of contaminants such as slushing compound, run-in oil, and metal chips.

Call the Shell Lubrication Engineer, or write for your copy of the Turbine Cleaning Manual. Shell Oil Company, Incorporated, 50 West 50th Street, New York 20, New York, or 100 Bush Street, San Francisco 6, California.

SEND FOR THIS BOOKLET NOW!

Every turbine owner and operator should have a copy. It contains full details on the Shell Turbo Cleaner and Shell Cleaning Procedure, and shows you how to get peak efficiency, lower operating costs.

SHELL TURBO OIL

DIGESTS

Condensations and abstracts of articles in the foreign press, committee reports, unpublished papers before numerous technical societies, research bulletins, standards

Studies of Wood-Destroying Fungi

From an article by John Leutritz, Jr., in "Bell System Technical Journal," New York, January, 1946.

LIMITATIONS of laboratory tests for evaluating fungicides have been largely overcome by using autoclaved topsoil for the substrate and pure cultures of the decay organisms. Research on the factors promoting decay showed that average topsoil furnishes nutrients and nutrilites in quantity and proportion highly favorable to many decay organisms, and also is an effective means of regulating the water content during the decay period.

Comparisons showed that decay with the wood soil contact technique is more rapid and uniform than in other laboratory methods or in field trials. Toxicity studies based on petri dish assays showed that the amount of a compound tolerated by several fungi varies considerably, and in general higher retentions of preservatives are needed to prevent decay than the assay indicates.

Field trials of preservatives, although in general less rapid, confirm results of the soil-contact method and in addition determine the degree of permanence of the preservative. Since the factors influencing decay are near optimum in the soil-contact method, any preservative that prevents decay in the laboratory test and is permanently retained will be effective under any climatic conditions.

Special Induction Heating of Metals

From a paper by Harold A. Strickland, Jr. (Budd Wheel Co.) before the American Society of Mechanical Engineers, Detroit, June 18, 1946.

INTERNAL HEATING and heat treating of metals are a special field in the realm of industrial heating. The coils are the most complicated of the induction coils, and to obtain efficiency in the limited space of an aperture they must have close tolerances. Most coils for the purpose are wound on laminated iron cores, without which the coupling would be poor, and with which the efficiency may equal or exceed that of an external coil. Sizes are for heating internal diameters from ½ in. to more than 12 in.

Special coils of almost any geometry can be built for the heating of odd-shaped pieces or introduction of odd heat patterns into regularly shaped pieces. In their design it is well to remember that (1) heat is produced only in the path of the current flow, which always attempts to be directly under and parallel to the current in the inductor; (2) current and flux never turn corners sharply; (3) the work must provide a complete path for the current; (4) the concentration of current in the workpiece, and hence the heating, varies inversely as the square of the distance between the inductor element and the work.

Induction heating for forging is the most recent widespread development. It is done primarily in heaters of two basic types, bar heaters and continuous billet heaters. The latter is mechanically loaded and may be coupled with hopper feeding mechanism. Steel of diameters of 1¼ in. or more can be heated to forging temperatures at the rate of about 6 lb. per hr. for each kilowatt of nameplate rating of the generator. Commercial energy is required at the rate of about 400 kw.-hr. for each short ton of steel heated. Other common metals may also be heated with at least as many pounds per hour per kilowatt as for steel.

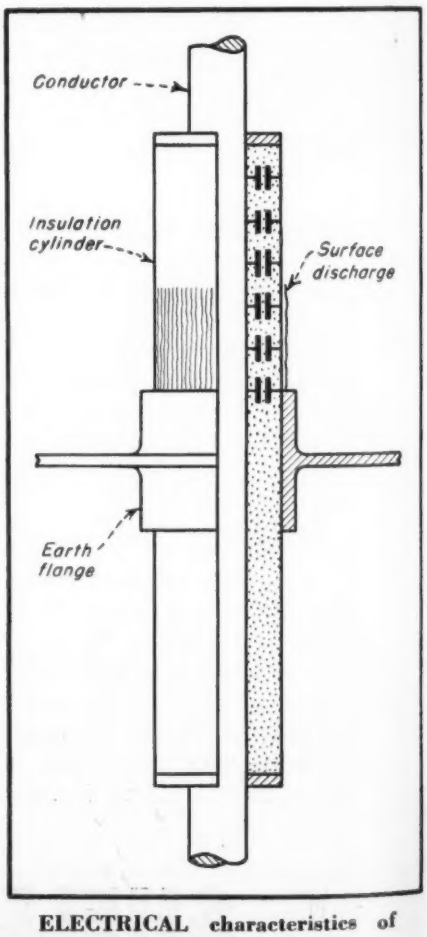
Forging with induction heating provides clean and cool working conditions, virtual scale elimination (which eliminates loss of metal, permits smaller machining stock allowance, and increase in die life as great as 4 to 1), extremely high speed operation, uniformity in temperature and heating time, less labor, and numerous other advantages.

Surface Discharge Of Bushing Insulators

From an article by E. G. Wright in "Electrical Review," London, May 10, 1946.

GENERAL SOLUTION of the electrical characteristics of bushing insulators is not practicable because of the complexity of the relations. Several methods, partly empirical, permit estimation of these characteristics, or at least obtain some general principles of design. Calculation of surface discharge voltage and spark-over voltage, based on laws of the gliding discharge and the conception of surface capacitance, is considered by the author.

If voltage on a simple bushing as shown in the diagram is increased sufficiently a glow occurs and streamers are produced. These streamers, which are conducting paths of high resistance,

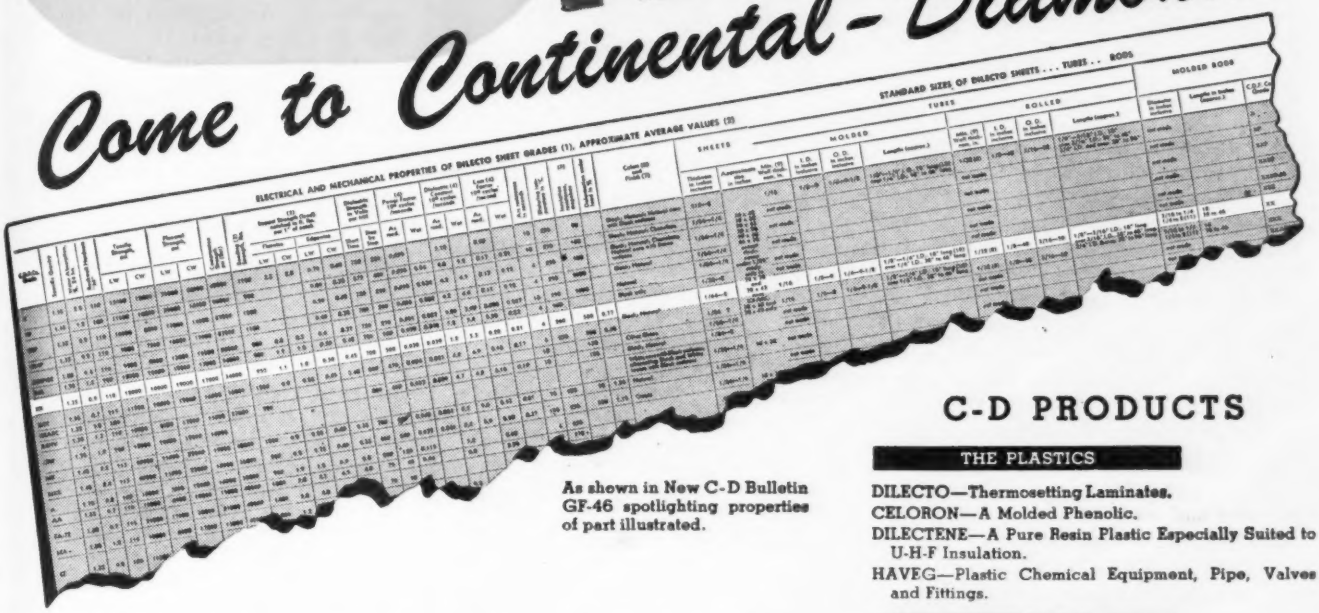


ELECTRICAL characteristics of simple cylindrical bushing

For the "WHERE and HOW to use WHAT PLASTIC"

Paper base Grade XX Dilecto part used in electrical equipment as an insulating terminal board . . . a strong, durable laminate with high electrical insulating properties and stability under extremes of temperature and moisture conditions.

Come to Continental-Diamond


ELECTRICAL AND MECHANICAL PROPERTIES OF DILECTO SHEET GRADES (1), APPROXIMATE AVERAGE VALUES (2)
STANDARD SIZES OF DILECTO SHEETS . . . TUBES . . . RODS

As shown in New C-D Bulletin GF-46 spotlighting properties of part illustrated.

For help in selecting and applying the non-metallic that will give you what you want in more effective insulation, let a C-D technician work it out with you. Make use of our research and engineering facilities which for half a century have kept up with the rising standards of product performance.

The right time to decide what material to use is while your product is in the planning stage . . . before blueprints and detailed specifications are completed. Save yourself costly errors in production and performance by knowing in advance the non-metallic that best meets your required electrical and physical properties.

As a starter, send for our new Bulletin GF-46 which contains engineering data on the complete line of C-D insulating materials.

SEE OUR CATALOG IN SWEET'S

SEC-46

C-D PRODUCTS

THE PLASTICS

DILECTO—Thermosetting Laminates.
CELORON—A Molded Phenolic.
DILECTENE—A Pure Resin Plastic Especially Suited to U-H-F Insulation.
HAVEG—Plastic Chemical Equipment, Pipe, Valves and Fittings.

THE NON-METALLICS

DIAMOND Vulcanized FIBRE.
VULCOID—Resin Impregnated Vulcanized Fibre.
MICABOND—Built-Up Mica Electrical Insulation.

STANDARD & SPECIAL FORMS

Available in Standard Sheets, Rods and Tubes; and Parts Fabricated, Formed or Molded to Specifications.

DESCRIPTIVE LITERATURE

Bulletin GF gives Comprehensive Data on all C-D Products. Individual Catalogs are also available.

Continental-Diamond C-D Engineered Non-Metallics

BRANCH OFFICES: NEW YORK 17 • CLEVELAND 14 • CHICAGO 11 • SPARTANBURG, S. C. • SALES OFFICES IN PRINCIPAL CITIES
WEST COAST REPRESENTATIVES: MARWOOD LTD., SAN FRANCISCO 3 • IN CANADA: DIAMOND STATE FIBRE CO. OF CANADA, LTD., TORONTO 8

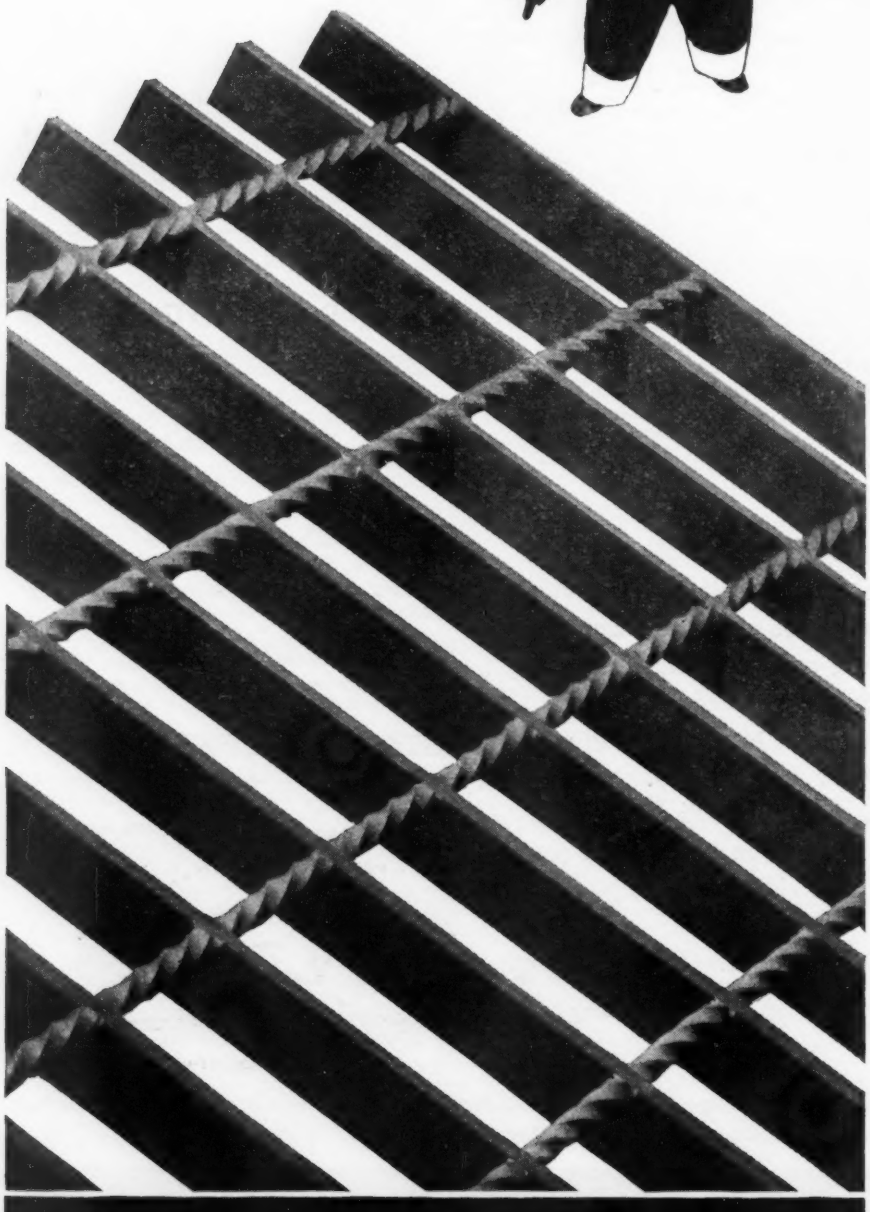
Continental-Diamond FIBRE COMPANY

Established 1895 . . Manufacturers of Laminated Plastics since 1911—NEWARK 15 • DELAWARE

See how the design of Blaw-Knox Electroforged Steel Grating permits maximum entrance of light and air . . . makes it easy to clean or paint . . . no bolts or nuts to rattle. Made for all floor loads.

"Look in there"

BLAW-KNOX DIVISION
OF BLAW-KNOX COMPANY
2013 FARMERS BANK BUILDING
PITTSBURGH 22, PA.



BLAW-KNOX ELECTROFORGED STEEL GRATING

progressively charge adjacent elements of the dielectric surface with a current $i = c\,dV/dt$, where c is the appropriate capacitance. When this current reaches a critical value gliding sparks occur.

The length, l_f (in cm.) of the fringe discharge streamers is, by an empirical relationship, $l_f = (V - V_o)K$, where V is the applied rms. kilovolts, K the increase in voltage needed to lengthen the streamers by 1 cm., and V_o the voltage where the experimental curve between streamer length and applied voltage cuts the voltage axis. In this article equations deduced by various experimenters are reviewed and values for V_o and K predicted for various dimensions. An equation for spark-over voltage also is given.

These values largely ignore such factors as humidity, conductivity of the solid dielectric and the surface film, capacitance of the bushing surface and other capacitances in parallel with the bushing. Omission of them for a particular test arrangement may not, however, be serious.

High-Temperature Lubricants

From an article in "Chemical and Engineering News," April 10, 1946.

AMONG USES for organosilicon products studied at the Mellon Institute by the fellowships of Corning Glass Works and Dow Corning Corp. is that of lubricants of greaselike consistency. The temperature range of the organosilicon lubricants has been extended so that they are now applicable at temperatures between −75 deg. and 200 deg. C. They are of value in the recently developed silicon-insulated motors that may operate efficiently at temperatures too high for conventional lubricants.

The field of organosilicon resins has been increased to include electrical insulating varnishes that cure at conventional temperatures, as well as heat-resisting paints and other products.

Generating Station Increment Costs

From a paper by F. H. Light before the Pennsylvania Electric Association, Harrisburg, May 29, 1946.

STEAM generating station increment costs, or additional production expense per kilowatt-hour resulting from an increase in station output, are the basis for determining the most economical interchange of power between interconnected systems and for allocating load to the generating stations. Factors in-

HERE and THERE with KELLOGG

Engineers—in various countries—speak different languages, but all recognize the fact that "there is no substitute for scientific design research" wherever high pressure piping is to be installed.

Consulting Engineers, Central Station and Industrial Power Plant Engineers—in the United States and abroad—know they can rely on Kellogg's ability to design, fabricate and erect piping installations, which perform as required, under the most advanced techniques of pressure and temperature.

While the figures shown include only high pressure and high temperature installations, The M. W. Kellogg Company has also designed, prefabricated and erected many piping jobs for lower pressures.

M KELLOGG W

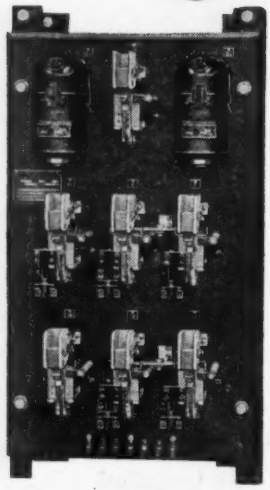
"Masterflex" Prefabricated Piping Systems • "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units • JUKK Processes for Lubricating Oil Plants. Plastic Refractories • Radial Brick Chimneys.

THE M. W. KELLOGG COMPANY • JERSEY CITY, NEW JERSEY • 225 BROADWAY, NEW YORK 7, N. Y.

REPRESENTATIVES

LOS ANGELES 609 SOUTH GRAND HOUSTON 2 TEXAS 402 ESPERSON BLDG TULSA PHILTOWER BLDG

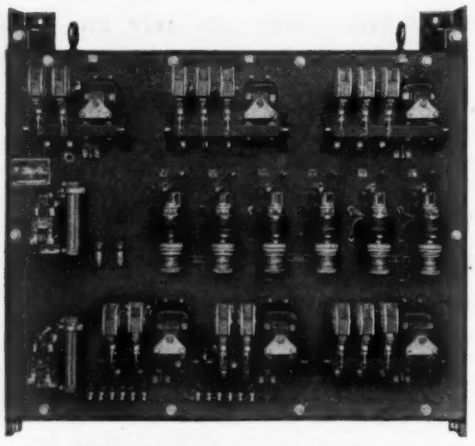
Modern Push Button Control for Floor Operated Cranes A-C OR D-C



Form FCR Controller for trolley or bridge motion—for direct current floor-operated cranes.

This EC&M standardized line of controllers is designed for (1) accurate inching, (2) compact mounting, and (3) minimum collector-bar requirements. They can be conveniently installed along the crane girders or mounted on the trolley, as required.

They have all the advantages of the well-known EC&M Control for *cab-operated* cranes. Contactors are of the heavy-duty, magnetic type. Resistors are carefully proportioned for low-torque hoisting of light loads and for smooth acceleration of bridge or trolley. All motions can be controlled from a single, pendant, master-station with two Push Buttons for each. Individual rope-operated Master Switches are optional.



15 HP Form FCHR-2 hoist controller—for a.c. floor-operated crane.

Send for Bulletins 922 (D.C.) and 931 (A.C.) which illustrate and completely describe these units.

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79th STREET • CLEVELAND 4, OHIO

volved in calculating the incremental production cost are: (1) the station increment coal rate; (2) fuel cost in the station bunker; (3) station operating factor; (4) the C_4 component of the maintenance cost factor, which is dependent on and proportional to the kilowatt-hours generated. The first three factors are combined to obtain the fuel increment cost in mills per kw.-hr., which equals one-half the product of the net increment rate in lb. per kw.-hr., the fuel cost in dollars per ton and the operating factor. The last item is the ratio of actual coal burned to bogie coal burned. The maintenance increment cost is the C_4 component of the maintenance cost formula, expressed in mills per kw.-hr.

It is highly desirable that a uniform basis for preparation of the increment cost data be adopted, so that production cost data for related systems are comparable. A thorough analysis of the performance of each generating station is essential to define correctly the shape of the incremental cost rate curve; and cost data for incremental maintenance cost should be reviewed periodically to establish correct components.

Rotating Power Regulators

From a paper by L. T. Rader before the Midwest Power Conference, Chicago, April 3, 1946.

USE of d.c. motors has increased greatly in recent years because they can be designed to have almost any required speed-torque characteristic and can be controlled with ease. In the latter field several schemes have been developed using d.c. machines as regulators to maintain a designated mechanical or electrical quantity at a predetermined value. Such are the General Electric "Amplidyne," the Westinghouse "Rototrol," and the Allis-Chalmers "Regulex Exciter."

Two systems of automatic control are possible, the open-circuit and the closed circuit. In the former an input signal from a controlling instrument is suitably amplified and drives a power device which performs the desired function. Such a system must be calibrated and if possible must hold the output independent of variables such as load, temperature, etc.

In the closed-cycle automatic system the signal is compared with a standard or with the input. The difference is amplified and transmitted to the driving apparatus in such a direction that the variation is eliminated. Such a system, sometimes known as a "servo-mechanism," has a feedback from output to input. It may control voltage or current of an arc furnace, position

ALL WHEEL DRIVE

"Moves Peak Pay Loads at Rock Bottom Cost"

The true measure of a truck's value is its ability to transport maximum payloads—*where you want them, when you want them—at minimum cost.* Unless your trucks perform all of these functions, *efficiently, reliably,* they are not giving you full value for your money.

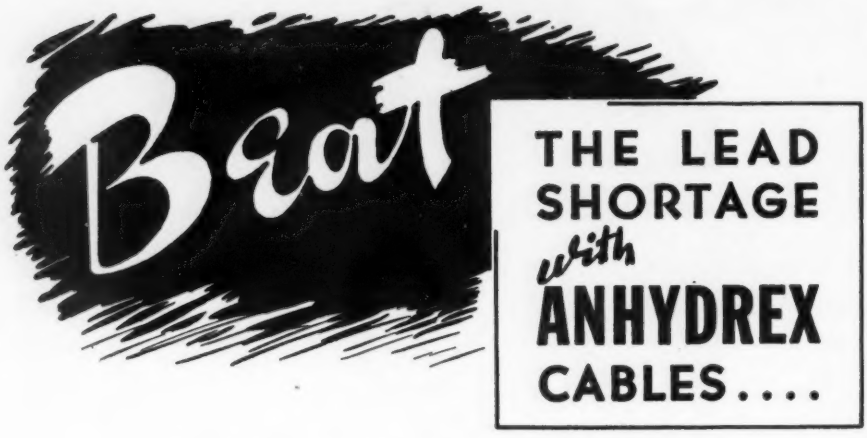
Marmon-Herrington *All-Wheel-Drive* Trucks do give you your full dollar's worth—*because they never let you down. All-Wheel-Drive* power and traction—*front wheels pulling, rear wheels pushing*—guarantee that Marmon-Herringtons will get you there and back—*on time . . . regardless of weather or terrain—on the highway or off.*

Throughout, Marmon-Herrington *All-Wheel-Drive* Trucks are built in proportion to their great power and traction. Frames, axles, springs, transmissions—they're all built super-strong to take peak payloads—without a whimper . . . *and do it for years and years and years.*

Yes, Marmon-Herrington *All-Wheel-Drive* Trucks are built big for big jobs. For a convincing demonstration that these great trucks live up to their reputation—both the Heavy-Duty models and *All-Wheel-Drive* converted Fords—see your nearest Marmon-Herrington dealer, or write for illustrated literature.

MARMON-HERRINGTON COMPANY, INC. • INDIANAPOLIS 7, INDIANA

MARMON-HERRINGTON ALL-WHEEL-DRIVE



All available indications point to the fact that lead for cable coverings will be short for the next year at least. But this lead shortage shouldn't unduly upset you for ANHYDREX Cables with a hard service rubber jacket will give you the dependable service you want without many of the difficulties that are inherent in the use of a lead sheath.

Simplex-ANHYDREX Underground Cables can be installed directly in the ground or they can be used in ducts. They are not subject to electrolysis or corrosion. Acid or alkaline soils have no effect on them. Sheath currents resulting in galvanic action cannot occur with a rubber jacket.

Simplex-ANHYDREX Underground Cables were the first to be offered with a low water absorption insulation and a hard service rubber jacket for use underground, without ducts.

Beat the lead shortage by buying and installing Simplex-ANHYDREX Underground Cables. A new ANHYDREX Underground Cable book is ready. We'll gladly send you a copy on request.

Simplex-WIRES & CABLES

SIMPLEX WIRE & CABLE CO. 79 SIDNEY ST. CAMBRIDGE 39, MASS.

of a machine tool, or any one of many industrial quantities.

An outstanding characteristic of these dynamoelectric amplifiers is their high amplification factor, which commonly is 20,000 to 50,000, although it may be as high as 1,500,000. Other features are fast time response, anti-hunt control, linear amplification, and reliability.

Internal Action

Methods of internal action of the three types differ, but all depend on a number of field windings which impress variations of the current in the control circuits on the output of the armature. These machines all have the ruggedness and reliability of present-day rotating equipment, and their use is consequently ever widening, competing in fields formerly considered electronic. They have improved immensely many electric devices and made practical others which previously could not be used.

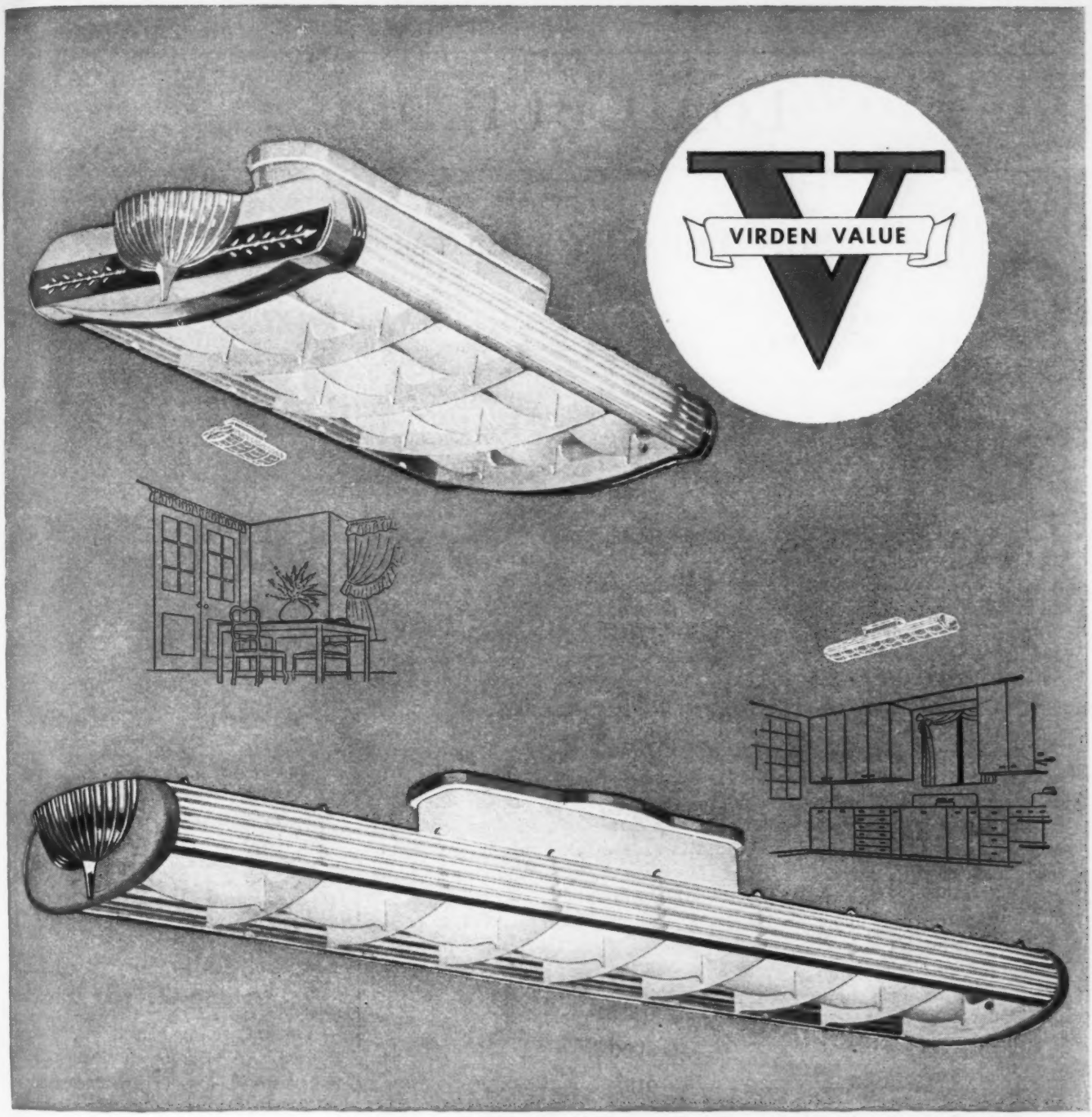
Selective High-Tension Relays

From a paper by Åke T. Vrethem and Gunnar Jancke (Royal Board of Waterfalls, Stockholm, Sweden) before the Conférence Internationale des Grands Résaux Électriques, Paris, June 27-July 6, 1946.

PROTECTION from short circuits on the 220-kv. system of the Royal Board of Waterfalls is primarily by distance relays provided with starting relays of unusual design and in conjunction with additional carrier current protective equipment. Special measures prevent the relays, as far as possible, from tripping circuit breakers in the event of hunting.

The neutral is grounded through arc-suppression coils with the result that most single-phase earth faults are cleared without actuating the relays and breakers. Sustained single-phase earth faults are cleared by an earth fault protective system which requires temporary earthing of the system neutral at one point through relatively high resistance. In this neutral, voltage relays and directional earth relays act in conjunction with time-lag relays. Both relay systems act in conjunction with high-speed automatic reclosing breakers.

With the carrier current protective devices, all faults on a line are trapped out simultaneously and without time delay from the ends of the line. This carrier current system, designed in Sweden, makes use of direct comparison between the phase angles of the positive and negative sequence currents at the ends of the line.



New RESIDENTIAL Fluorescents...ready soon

• At the top a new 4, 20-watt lamp fixture that will be widely used in residential lighting for both kitchen and dining room lighting. A ceiling fixture of the first rank. Utilizes plastics for both decorative and lighting effect. No need to tell you it's rich in beauty and will go over big. It's right in price, performance and personality. • Below is our 2, 40-watt lamp unit for the kitchen. Your customers will like it.

Virden jobbers are always glad to co-operate.

John C. Virden Company • Cleveland, Ohio

Member American Home Lighting Institute

LOAD BUILDING

Dry Trailer Bodies In Ten Minutes

P. R. SMITH
and A. L. POTTER
Electricity Sales Dept.
Commonwealth Edison Co.
Chicago, Ill.

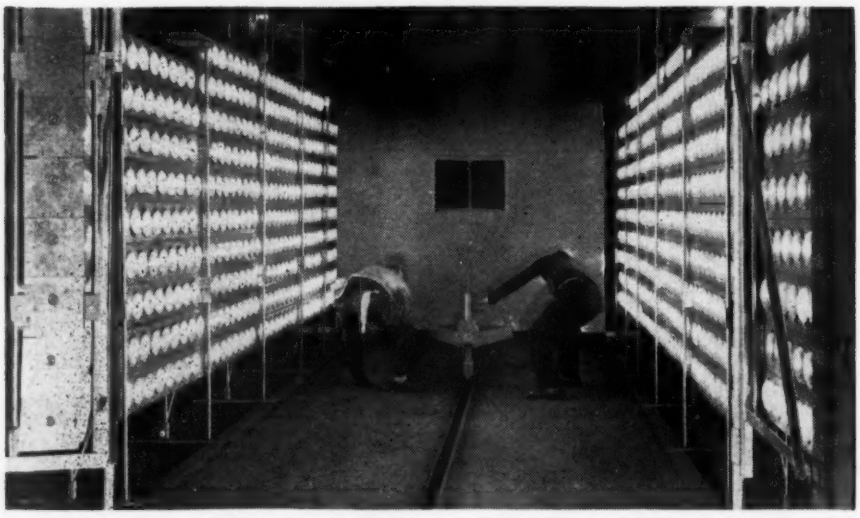
DRYING painted Masonite board with infrared radiation has been considered a questionable application for some time by both the makers of drying equipment and the paint companies. However, special paints which have become available with the termination of the war have contributed to the solution of this knotty problem and recently made it possible to dry painted Masonite trailer bodies in ten minutes with infrared heat at the Indian Trailer Corp., of Chicago.

Paint samples used in early laboratory tests, undertaken in studying this project, blistered badly under infrared radiation. Subsequently, however, DuPont Co. submitted a synthetic enamel with a specially compounded primer. Sherwin-Williams also became interested and prepared special samples for this application. Both these new samples were a success. Blistering was eliminated and proper drying cycles were obtained in the laboratory. These cycles were four minutes at full-voltage, for the primer coat, and ten minutes at half-voltage for the finish coat.

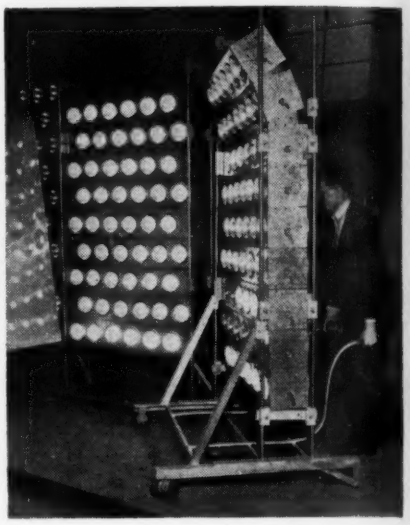
For uniform drying coverage of the trailer body a tunnel was recommended that consists of 908 R-40 250-watt reflector lamps. This load was balanced on three phase and switching provided for time clock control and also to permit separate control of upper and lower lamp banks for drying two-tone trailers.

A 10-min. drying cycle coincided best with the company's desired production schedule and was consequently adopted for both the priming and finish coats. Since this called for operation at one-half voltage the wiring cost was substantially reduced and the load also was only 36 percent of the total lamp wattage or 82 kw.

Present production schedule requires that the lamps be on ten minutes and off five. Annual cost of operating the tunnel on this schedule is $2,600. Its use, however, has speeded production to the point where it is possible to ship trailers within one-half hour after painting, thus completely eliminating the storage space required for longer drying periods.



DRYING TRAILER BODIES—Dried in this infrared tunnel, painted Masonite trailer bodies can be shipped a half-hour after painting. The 908 lamps in the tunnel operate at half voltage; drying cycle is 10 min.



MOBILE TUNNEL SECTION — Ends of the trailer body are dried by mobile lamp banks that can be wheeled into place as shown. Note how bank has been adjusted to the shape of the trailer top

•

For Success in Selling Electric Ranges

TWENTY fundamentals for a successful range sales program were stated for dealers at a recent meeting of the Electric Institute of Boston by J. P. Maloney, vice-president, Eastern Co., Cambridge, Mass., in a talk entitled, "How to Get into the Electric Range Business." They are:

1. Obtain a franchise for a good electric range.
2. Install an electric range in your own home.
3. Set up a range department in your store.
4. Display the complete line of ranges.
5. Put an electric range in your window.
6. Demonstrate the electric range.
7. Sell electric cookery.
8. Follow up your previous appliance sales for prospects.
9. Survey homes to determine age

Sure Cure for Hay "Fever"

h This New Electrical Resistance Thermometer

ATCH that hay! When it runs a temper- ature it may ignite and burn down rn. That's spontaneous combustion and vent it an extremely sensitive Electrical nce Thermometer Bulb, developed by n-Splitdorf Corporation, is used to detect rature changes.

Not only does this wonder bulb detect eating in hay mows; it also determines nd and air temperatures in green- s—reports temperature changes in the ngs of power station generators, rail- cars, vital spots of airplanes, chemical ons, hospital rooms and even in patients going operations. Its uses are unlimited t will measure temperatures ranging -200° F to 600° F in solids, liquids and . Time constant is less than 2 seconds.

The heart of this bulb is a resistance nt wound with a wire having a Temper- Coefficient of Resistance of .00636 per e C. A change of 1° C produces a .39 ohms change in the unit which in turn produces a corresponding change in the current flowing through the recording meter.

Although this type thermometer has been used in industry for many years it was never successfully developed for volume production because of a lack of an adequate supply of a resistance wire with a stable T. C.

Spurred by the urgency of the war, Driver-Harris Metallurgists working with Edison Engineers speedily developed D-H 99 Alloy to meet this need. It is a resistance wire having a stable T. C. of .00636 per degree C when drawn to .002" diameter and available in large quantities with dependably uniform properties from spool to spool.

Today Driver-Harris manufactures over 80 electrical *heat and corrosion-resistant* alloys. If, like Edison-Splitdorf, the allay wire you need has not been developed, tell us about it. We've solved many difficult metallurgical problems in 47 years.

1. STAINLESS STEEL BULB
2. PORCELAIN SEAL
3. D-H 99 ALLOY
4. SILVER SPRINGS
5. MICA INSULATION

Construction details of the temperature sensitive element which is hermetically sealed into the stainless steel bulb of the Edison-Splitdorf Electrical Resistance Thermometer. Made for the Foxboro Company and other instrument manufacturers.

D/H
SPECIAL PURPOSE ALLOYS SINCE 1890

Driver-Harris
COMPANY
Exclusive Manufacturers of Nichrome
HARRISON, N. J.

BRANCHES: Chicago • Detroit • Cleveland
Los Angeles • San Francisco • Seattle
The B. GREENING WIRE COMPANY, LTD.
Hamilton, Ontario, Canada

Picture of an off-peak friend

Here's the off-peak load-builder you've been looking for . . . the G-E Automatic Blanket!

"Working hours" for this electrically controlled blanket are *bedtime to breakfast time.* And here's the kind of load-building you can expect . . . Two G-E Blankets equal one six-foot refrigerator in kilowatt hour consumption.

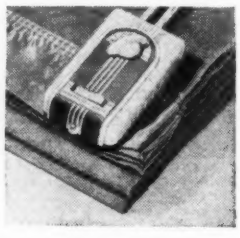
Tell your customers about this soft, lightweight, electrically warm blanket . . . this wonderful way to sleep *undisturbed* all night long.

We're telling them too—with full-color ads in top-circulation magazines, plus frequent mention on "The G-E House Party," coast-to-coast air show over CBS.

And we're telling them about a big new G-E extra—*in addition* to the G-E One-Control Blanket. The new Two-Control Automatic Blanket—*exclusively* G-E!

Two separate controls, one for each half of the blanket, can be set separately. Double-bed sleepers can snooze happily under one blanket—at the comfortable temperatures they select on their separate Bedside Controls.

Write us today for complete information, including ways to make the most of this new load-builder that works while your customers sleep! General Electric Company, Appliance and Merchandise Dept., Bridgeport 2, Conn.



Automatic Blanket

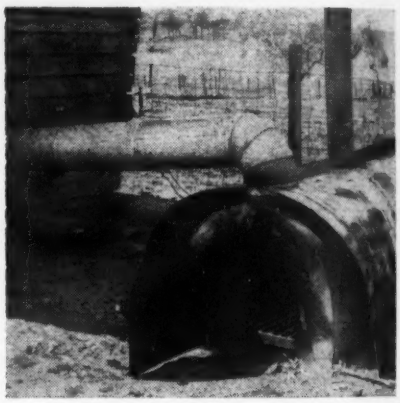
"Goes to work when the lights go out"
Approved by Underwriters' Laboratories, Inc.

GENERAL ELECTRIC

and condition of cooking equipment.

10. Concentrate your sales activities with middle and higher income groups.
11. Build a prospect list.
12. Make each electric range sell three.
13. Be familiar with rates and installation costs.
14. Take advantage of utility newspaper advertising.
15. Advertise on your own account.
16. Learn the features of the range.
17. Provide servicing facilities.
18. Install a water heater in your store.
19. Train your new sales personnel.
20. Urge your prospects to attend electric cooking schools.

•



FORCED-AIR CORN DRYER—For drying ear corn in the crib this special air heater was built by Adolph Hanna, Belleville, Wis. By means of a small fan, air is circulated around the fire box and is discharged into the pipe leading to the duct in the crib. The Hanna farm is served by Wisconsin Power & Light Co. with headquarters in Madison

•

Motor-Driven Car Washer Cuts Cost

PASSENGER CAR washing at the rate of one car per minute has been achieved at the Somerville (Mass.) yard of the Boston & Main Railroad. Washing units manufactured by Whiting Corp., Harvey, Ill., have been in operation there since January 6, and the number washed to March 31 was 6,410. This represented washing during a period when low temperatures restricted cleaning operations. At present, over 200 cars are being washed in a 24-hour day, depending upon the time required to move cars between the washing ma-

Sherman Split Bolt Connectors

Full hexagon head of generous size — six big, flat surfaces for wrench jaws to grip at any angle. A real aid to fast, easy, tight assembly.

●

No sharp edges or corners to cut hands or tear lineman's rubber gloves.

●

Die cut threads (not pressed or stamped) checked with precision gauges to mate perfectly with tapped threads in nut.

●

Solid reinforced spacer — won't distort or collapse and allow threads to strip. Also provides maximum bearing surface on wire with minimum friction on nut.

●

Body machined from No. 3 (free cutting) silicon bronze. Nut is coined from No. 1 silicon bronze. Both alloys average over 90,000 lb. tensile strength per square inch.

●

Extra thick nut, provides more threads and greater bearing surface — permits greater leverage in tightening.

●

Extra long pilot — makes it easier to start the nut.

●

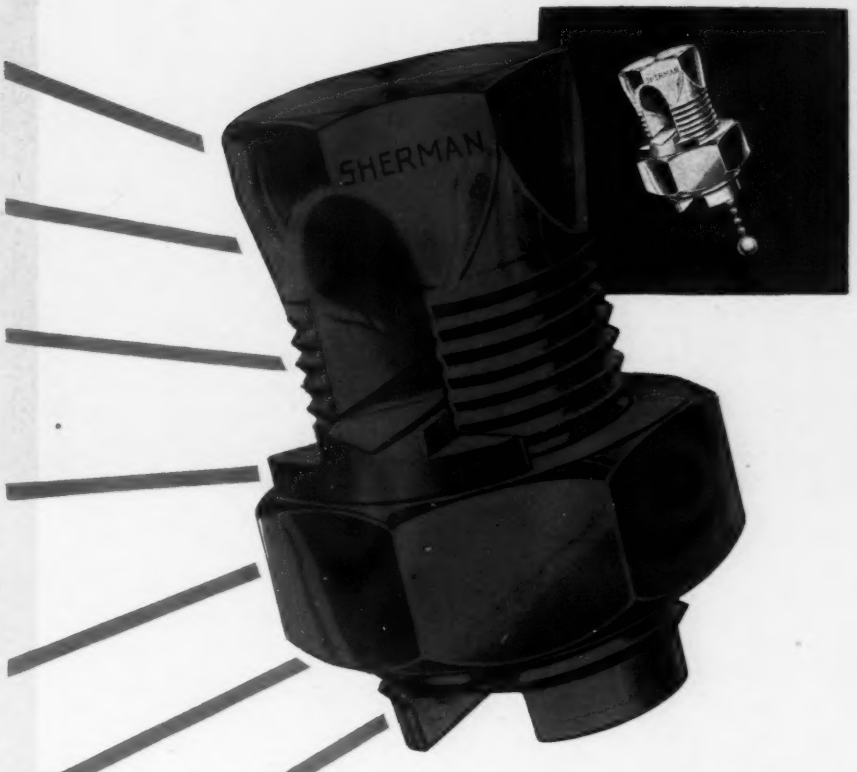
Made in full range of sizes from No. 10 to 1,000 MCM wire, including extra length connectors which will take three wires.

●

Sizes from No. 6 through No. 1/0 can be furnished with non-tangling bead chain nut retainer.

●

All connectors clearly stamped on the head with the trade name, "Sherman," as well as the catalog number and wire size. Packed in sturdy metal edge cartons plainly labeled.



Split Bolt Connectors, to be considered satisfactory today, must measure up to extremely high standards.

These connectors must take considerable punishment, both in installation and in normal service. They are under a continuous strain, yet they must maintain a tight, permanent joint, since any failure of the connector means an interruption in service, coupled with extra work for the service men.

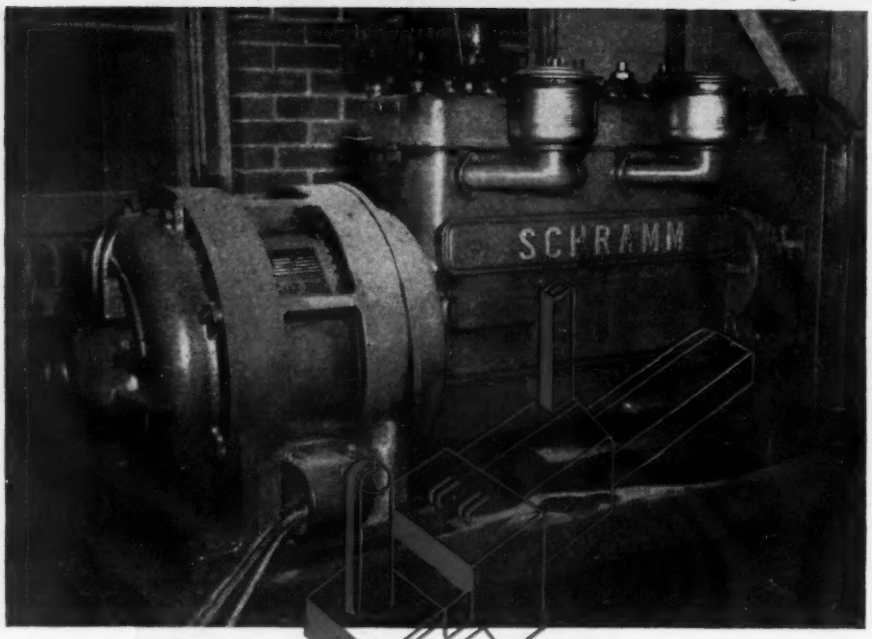
Sherman Split Bolt Connectors are not only made to meet all these requirements, but are also designed to facilitate quick, easy installation. We sincerely believe that there are few other connectors on the market today that can approach Sherman quality.

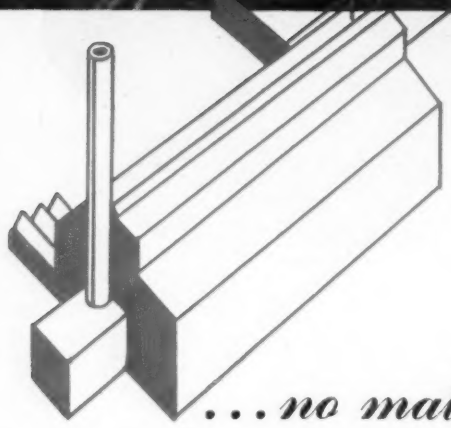
At left are shown some of the outstanding features of these Sherman Split Bolt Connectors. We strongly recommend an earnest consideration of these features by every engineer concerned with specifying connectors of this type.

50 YEARS 1896 S 1946 OF LEADERSHIP

H. B. SHERMAN MFG. CO., BATTLE CREEK, MICH.

VIBRATIONLESS





. . . no matter where

SCHRAMM AIR COMPRESSORS

are installed in your plant!

No vibration . . . but all the air you want! Schramm Air Compressors are easily installed, require a minimum of space, and are compact: yet NO VIBRATION!

Schramm Air Compressors are specified by industry today because they furnish all the air you want, whenever and wherever you want it. Each unit is tested before it leaves the factory, and goes to work as soon as it is installed.

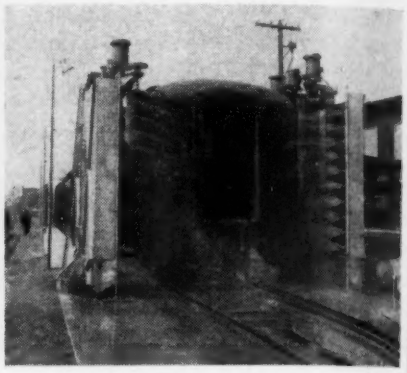
Both stationary and portable units are available, in every size mounting and assembly. A new Booklet giving full construction details and advantages you get with Schramms is yours for the asking. Write us today for your copy.

SCHRAMM INC.

THE COMPRESSOR PEOPLE
WEST CHESTER
PENNSYLVANIA

chine and the various rail yards.

Washing involves two operations. Cars are brought to a special platform at one end of which is a washing unit with heavy brushes mounted on vertical shafts that are driven by V-belts from electric motors. As a car approaches the washer, the brushes are swung out to meet each side. This



PASSENGER CAR travelling through Whiting car washer. Revolving brushes, motor-driven, contact sides and windows of each car as it passes through a first unit using water or cleansing compounds, followed by clean water spraying from another unit 210 ft. distant. The rate of car travel during a wash is about one mile per hour and over 200 cars per day at the rate of a car per minute can be washed by this equipment

is performed by compressed air at about 40 psi., and is followed by starting the motors which revolve the brushes. At the same time water at city pressure (50-60 psi.) is turned on or acid compounds are used, depending on the condition of the car. Travelling at the rate of about one mile per hour, the car passes through a rinser using clean water, removing all traces of dirt and grime from sides and windows.

A car-washing crew comprises an operator stationed in a control booth located midway between washing units and at one side, and two platform attendants. Compared to this force, hand washing rates are estimated two man-hours per car for water washing and 16 man-hours per car for acid or cleansing compound washing.

The electrical equipment consists of four 3-hp. Ideal motors, rated 1,160 rpm., 3-phase, 440 volts, and vertically mounted, driving 9-ft. brushes per unit; and two 2-hp. Ideal Manufacturing Co. motors, rated 1,160 rpm., 3-phase, 440 volts, vertically mounted, driving window-wash-

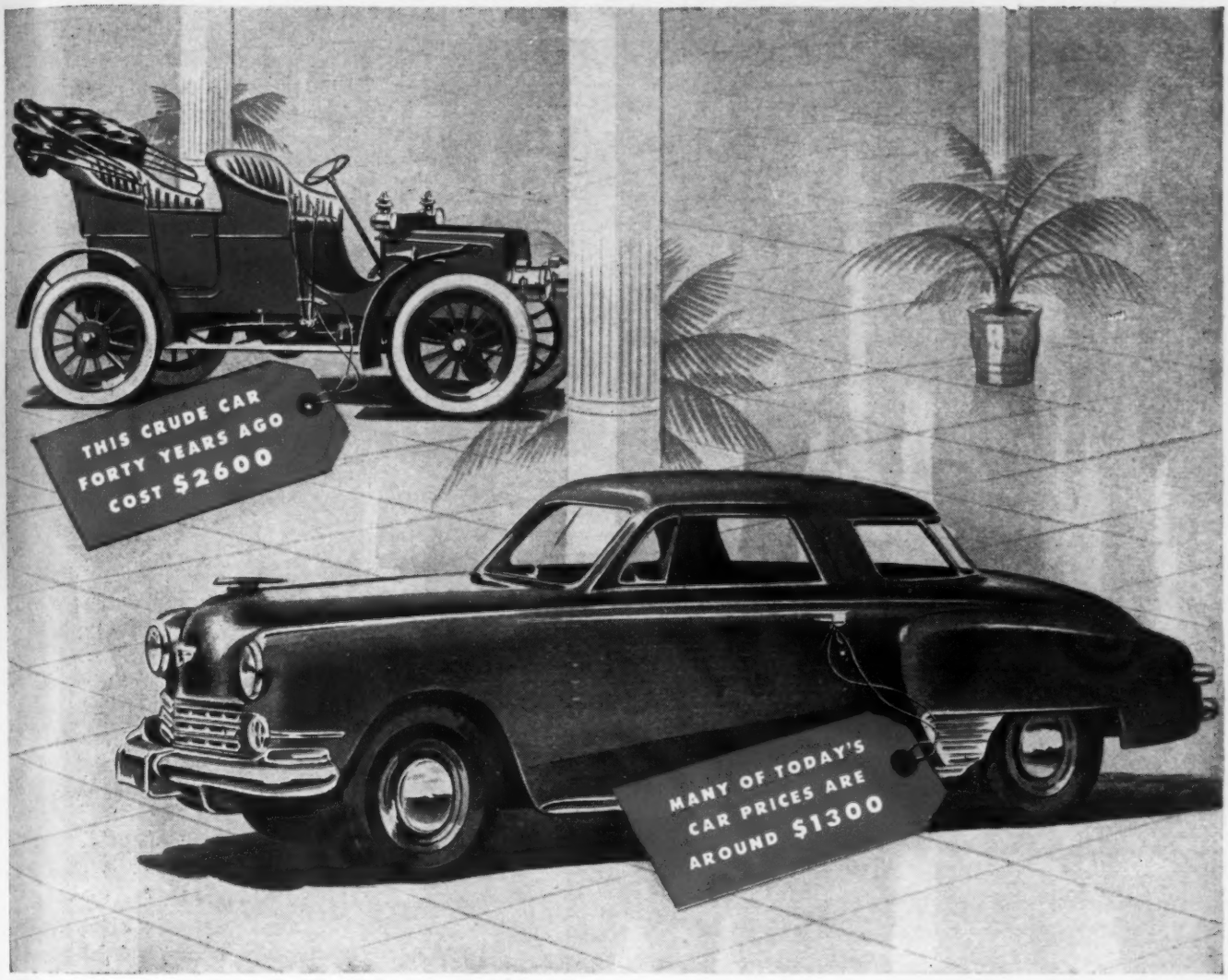


Figure it out . . . Work Pays!

Four Cars "for the Price of One"

In terms of automobiles, see how work pays! Production 40 years ago was less than 50,000 cars annually. Prices then were more than twice the cost of cars after production had climbed into millions per year. *Values* today are many times greater. *Purchasing power* of the average wage-earner has more than *doubled*. Conservatively stated, this means that the public gets the equivalent of about *four* fine motor cars today for less than the relative investment in *one* in 1906!

Many other examples of how work pays could be cited. Only through increased production . . . not slow-downs or idleness . . . can real income-increases be attained. Distortions of that truth may persist, but the fact remains. And the public must be reminded, repeatedly, that only through increased production can the masses benefit by technological advances of recent years in industry.

To help manufacturers improve their production and their products, MOSINEE paper technicians are ready to work. Call us!

MOSINEE PAPER MILLS CO. MOSINEE, WISCONSIN

MOSINEE PAPER MILLS COMPANY

MOSINEE • WISCONSIN

Essential Paper Makers

Please address your letter "Attention Dept. B"

UPTEGRAFF
Power
Transformers

(shown above) a typical Uptegraff Power Transformer, Type OISC, 3000 KVA, 3 phase, 60 cycle, 22,000 volts delta—550 volts delta.

for UTILITY SERVICE

It is the sureness of satisfaction, through Quality and Service, that has won Uptegraff Power Transformers their high standing.

Built to completely fulfill every requirement of all applicable standards of AIEE, NEMA, EEI and ASA specifications, and designed to meet the job at hand, you find your immediate and long-range plans completed with Uptegraff Power Transformers.

Write for Bulletin No. 111
and tell us your requirements

NEMA

R. E. UPTEGRAFF MFG. COMPANY
SCOTTDALE, PENNSYLVANIA U. S. A.

ing brushes. All operations are controlled manually. Power is supplied by Boston Edison Co. and energy used is estimated at 0.5 kw.-hr. per car.

•

Booklet Answers Customers' Questions

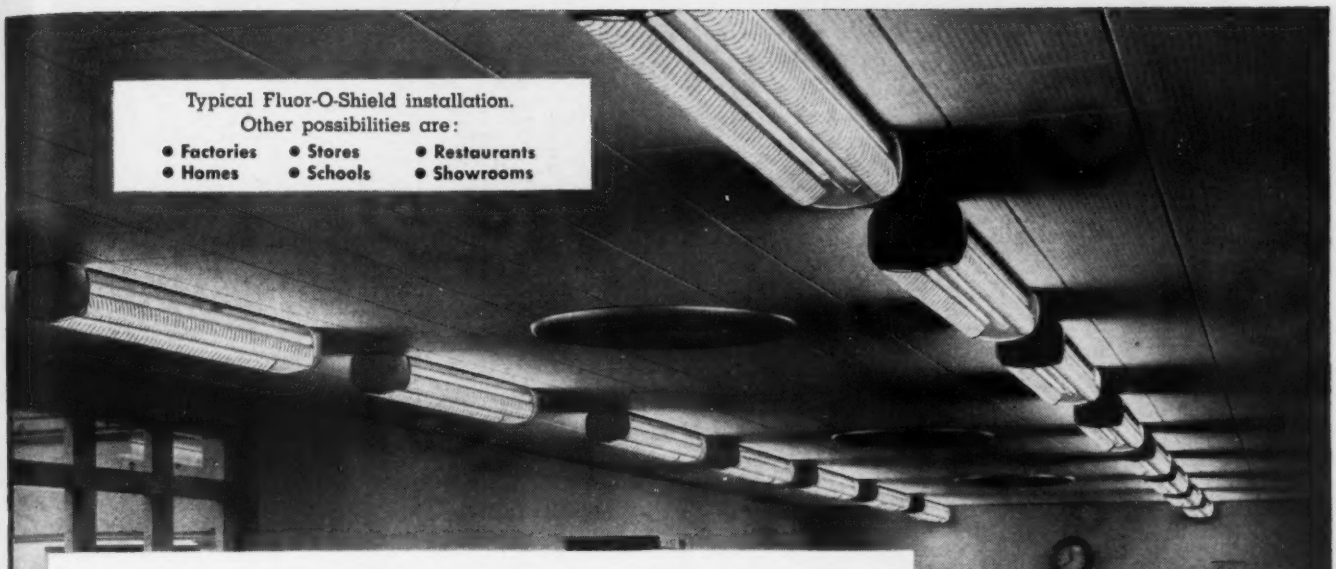
"LET's Get Better Acquainted," says Reddy Kilowatt on the cover of an informational booklet of the Western Massachusetts Electric Co. Intended originally to be handed to new customers at the time of application for service, the booklet soon found other avenues of distribution because it supplied a real need. Answers to customer inquiries are accompanied by copies of "Let's Get Better Acquainted" and one is left in each home where a company representative calls in response to complaint or to request of any kind.

Contained in the 16 pages of the booklet, which is 4 in. by 8½ in. in size, are instructions on how to read the meter, how to figure the bill, how to replace a fuse, what to do in case of trouble, how to use appliances effectively, what the uses of them cost on W.M.E. rates, where and how to obtain advice on lighting, home building, wiring. Also included are explanations of policy regarding credit deposits and of reasons for variations of bills from month to month.

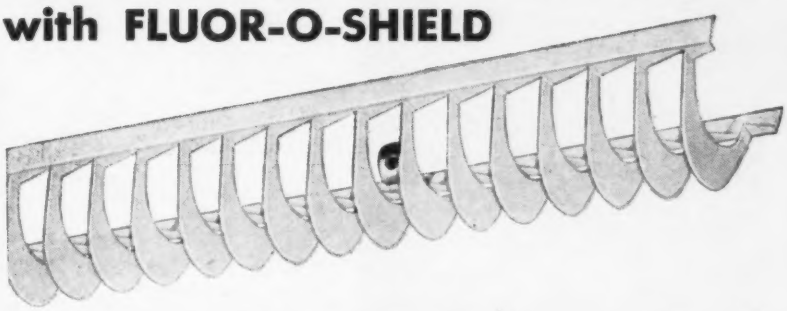
•

Defines Appliance Market for Dealers

WHAT to sell and where to sell it are the principal content of a cooperative sales manual distributed to dealers in the service territories of the Florida Power Corp. and the Georgia Power & Light Co. The book, a production of the two affiliated companies, presents detailed analyses of sales potentials in new and replacement appliances, in new homes construction, in all-electric kitchen modernization, and among commercial users of electric service. This information is tabulated by company districts so that dealers can see the possibilities of the market immediate to them. The book also tells about the extensive promotional activities which will assist dealers' sales and sets forth the policies of the companies, who do not merchandise, regarding financing of sales, servicing of appliances, and training of dealer personnel.



92% of the light...none of the glare with FLUOR-O-SHIELD



easy to attach — low unit cost — easy to sell

Multiple sales of Fluor-O-Shields are turning in quick profits for dealers and contractors all over the country. Here's the reason: the numerous advantages of Fluor-O-Shields can be demonstrated right at the point of use without expensive sales technique. Endorsed by lighting engineers, lamp tube manufacturers, and electrical testing laboratories, Fluor-O-Shields give *92% of the light* of bare fluorescent lamps, with none of the glare. This results in better lighting for better working conditions, more working efficiency. Lightweight, ease of attachment and all-around efficiency make Fluor-O-Shield the most practical light diffuser on the market. If your distributor does not stock Fluor-O-Shields, write for name of our distributor, or ask your distributor to write us.

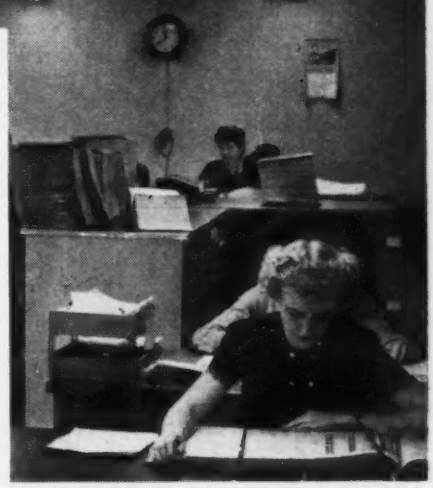
- **Fit most exposed lamp fluorescent fixtures.**
- **Simply snap on or off lamp tubes — instantly attached or removed without bolts, screws or tools.**
- **No strain on lamps or sockets. 1-piece, light-weight aluminum, finished in white baked enamel.**
- **No soldered connections to break or pull loose. No horizontal surfaces to collect dust or dirt.**
- **Modernize and improve appearance of exposed lamp fixtures at surprisingly low cost.**
- **Low stock investment, convenient to stock, packed nested to take little space, move out rapidly.**
- **Combination sales item along with fluorescent lamp tubes and starter replacements.**
- **Available in two sizes for 20W and 40W lamps. Shipped ready for immediate attachment.**

$1.95 40 watt 46⅞ in.

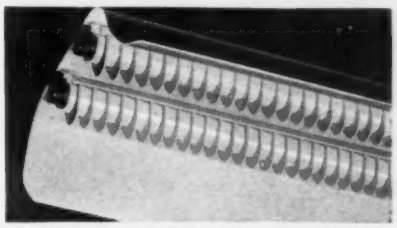
$1.25 20 watt 22⅞ in.

FLUOR-O-SHIELD*

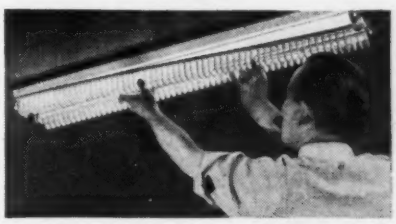
Light Diffuser for Fluorescent Lamps



Offices of Starr Machinery Co., Seattle, Wash.



Fluor-O-Shields fit most exposed lamp fixtures. Eliminate glare, eyestrain, stroboscopic effect.



Snap-on clips provide instant attachment or removal without bolts, screws or tools. Burned out lamps changed quickly and easily.

Represented Nationally by
D. E. SANFORD CO.
NEW YORK • BOSTON • PHILADELPHIA
ATLANTA • CLEVELAND • CHICAGO
ST. LOUIS • SAN FRANCISCO
LOS ANGELES • DALLAS • SEATTLE

*Trade Mark — Patent Pending

FLUOR-O-SHIELD* by CAMFIELD MANUFACTURING COMPANY • GRAND HAVEN, MICHIGAN

NEW EQUIPMENT

Coil Testers Detect Defective Coils

TWO NEW coil testers designed to detect short circuits and defective insulation in high-speed production testing of electric coils have been announced by the General Electric Co., Schenectady 5, N. Y. The new testers, available for high-voltage or low-voltage applications, are useful for testing such coils as those to be assembled into small motors, relays, radios, transformers, and instruments.

The low-voltage tester shows the presence of short-circuited turns in a coil. The turn-to-turn voltage is insufficient to break down partially faulty insulation. The high-voltage tester is used when an overvoltage test is required for the insulation between turns and layers of coils. The turn-to-turn voltage in the high-voltage tester is high enough to stress the insulation beyond service requirements.

On the front of the low-voltage tester are mounted the short-indicating milliammeter, the sensitivity and balance controls, and the power switch. The coil to be tested is placed over the end of an iron core located on the top of the instrument, and a 60-cycle voltage is induced in the coil. If there are any short-circuited turns, the resulting current flow will be shown by deflection of the indicating instrument. So that a variety of coil sizes may be tested with this instrument, interchangeable ½-in. and ⅛-in. square cores are available.

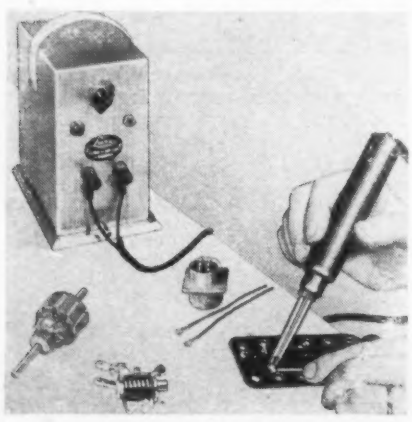
The high-voltage tester has two indicating instruments on the front panel, one measuring the applied field, from which the induced volts per turn may be determined, and the other indicating faulty coils. Without a test coil on the iron core, volts per turn are adjusted to the desired value by a dial, and the fault-indicating instrument is adjusted

either to read zero or give minimum deflection. The coil to be tested is then placed over the iron core in the test cubicle which is accessible from the front of the instrument. When the interlocked cubicle door is closed, the 2,000-cycle test field is applied to the coil under test. A fault in the coil will result in deflection of the fault indicating instrument. Three core sizes are available for use with this tester, permitting testing of a wide range of sizes.

•

Soldering Tool Has Wide Wattage Range

A RESISTANCE-TYPE soldering tool, which is available in two power unit models and a choice of eight basic single or carbon electrodes and which may be used on light precision work or heavy industrial soldering, has been developed by Luma Electric Equipment Co., 909 Prospect Ave., Toledo 1, Ohio.



Four ranges of power units are available, two single- and two multi-stage. The two single-stage tools have a range of from 1,050 to 1,225 watts; the two multi-stage, from 1,575 to 2,500 watts. The multi-stage unit is illustrated and it is equipped with a selector switch which controls the temperature at any one of six different settings, depending upon the soldering job at hand.

Electrodes, which are equipped with 5-ft. flexible cables, range in size from 3/32 to ½ in. in diameter. The 3/32-in. electrodes in both single and double types are adapted to light terminal work, jewelry, armature, fuse, radio, and microphone manufacture and harnessed assemblies. For heavier operations, the 5/32-in. electrodes are used. For spot soldering and work involving seams and large terminals, the ⅜- and ½-in. single carbon or roller type is recommended.

All units are fibre-glass insulated and are designed for continuous operation. The tool requires no warm-up time. Full operating current flows only when the electrode is in contact with the work. A 10-watt energizing current is drawn during non-soldering periods.

•

4,500-Deg. Fluorescent Tubes Made Up to 40-Watt Size

THE 4,500-DEG. white fluorescent lamp has been added to the products produced by Champion Lamp Works, 600 Broad St., Lynn, Mass. All sizes of preheated regular tubes from 14 watts to 100 watts, as well as the instant-start, 40-watt T-12 lamp, are included.

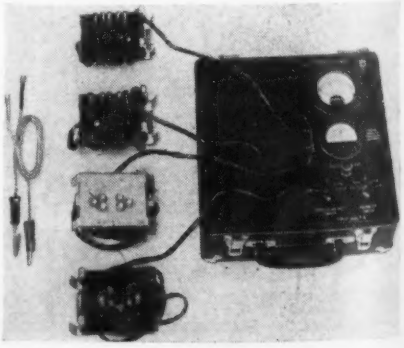
The new white is an intermediate color between the 6,500-deg. daylight lamp and the 3,500-deg. white. It is warmer than the white and cooler than daylight.

A 40-watt, 4,500-deg. white is rated 52 lumens per watt which compares with 58 lumens per watt for the 3,500-deg. white lamp and 48 lumens per watt for the daylight of the same size.

•

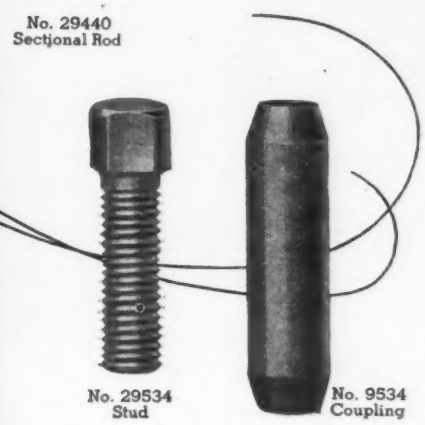
Voltage Regulator Balances Plane Generators

A NEW, portable aircraft voltage regulator to balance generator output on all multi-engine planes has been an-

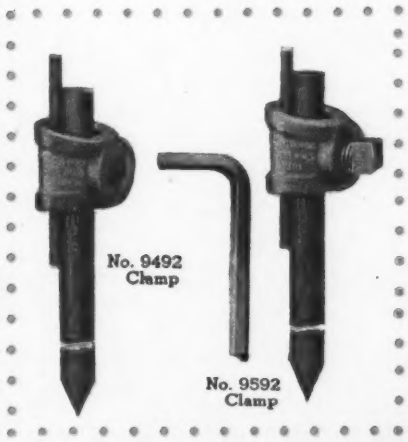


The Endurance of Copper-Plus The Strength of Steel

HUBBARD-COPPERWELD SECTIONAL GROUND RODS



Hubbard-Copperweld Sectional Ground Rods have been designed for use in locations where deep grounds are necessary to reach firm soil. The use of sectional rods eliminates the nuisance of extra long rods which are clumsy to handle in the warehouse and on the truck. Sectional rods are the same as standard except that they are threaded on each end. Joining is accomplished by couplings as shown. For driving purposes a stud bolt is inserted in the coupling at the top of each section.



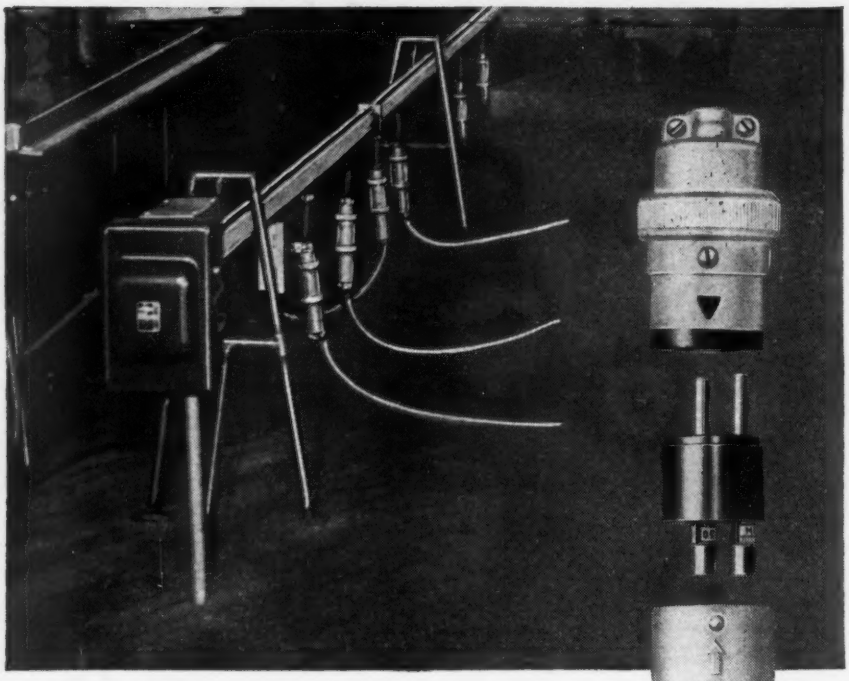
Assembly of Sectional Rods—Couplings and Stud

Stock No.	Description	Size	Approx. Wt. per 100 Pcs.
29430	Sectional Rod	1/2" x 10 Ft.	550
29440	Sectional Rod	5/8" x 10 Ft.	860
29450	Sectional Rod	3/4" x 10 Ft.	1220
9533	Coupling	1/2"	18
9534	Coupling	5/8"	30
9535	Coupling	3/4"	46
29533	Stud	1/2"	15
29534	Stud	5/8"	23
29535	Stud	3/4"	35
9491	Safety Set Screw Ground Clamps	1/2"	25
9492		5/8"	35
9493		3/4"	45
9591	Sq. Head. Set Screw Ground Clamps	1/2"	25
9592		5/8"	35
9593		3/4"	45

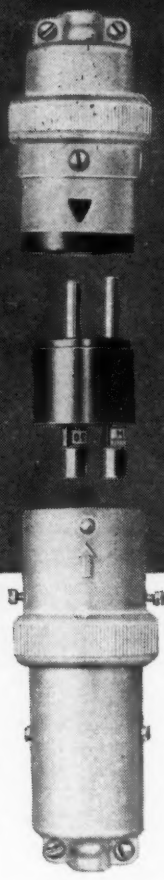
HUBBARD AND COMPANY

PITTSBURGH · CHICAGO · OAKLAND, CALIF.

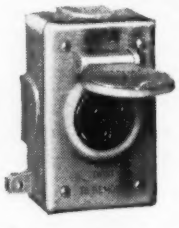
EXCLUSIVE NATIONAL SALES AGENTS FOR COPPERWELD GROUND RODS AND CLAMPS



Battery of EVER-LOK connectors on FEEDRAIL in textile plant



2-wire 3 pole EVER-LOK with midget or Busman fuses.



EVER-LOK receptacles, also available in gang type.

EVER-LOK AUTOMATIC LOCKING RECEPTACLES, CONNECTORS & PLUGS

Where uninterrupted service is vital, Ever-Lok connectors insure against faulty contacts, vibration and accidental separation. They are the preferred standard for the connection of high cycle tools and portable equipment.

Locking is automatic and positive. Plugs cannot be inserted the wrong way. Steel clad, dust-proof, self-wiping and self-aligning contacts and positive grounding.

EVER-LOK is made in 2, 3, and 4 pole, 10 to 200 amperes and 2 to 11 pole for signal and control service.

Available in the form of receptacles and plugs for outlet and conduit boxes, surface and gang types, reverse and multiple circuit, weathertight and for cord connectors and also many special modifications not listed in the R. & S. catalog.

Ask for the 300 page R. & S. Catalog.

Since 1902

Please address Dept. No. B

RUSSELL & STOLL COMPANY

EXPLOSION-PROOF, WATER-TIGHT, INDUSTRIAL LIGHTING FIXTURES AND EQUIPMENT. AUTOMATIC LOCKING "EVER LOK" CONNECTORS

125 BARCLAY STREET · NEW YORK 7, N. Y.

33

nounced by Airquipment Co., 2820 Ontario St., Burbank, Calif.

The new instrument has a 2 percent base accuracy plus a sensitive adjusting mechanism which permits perfect synchronization and eliminates the danger of "boiling" new batteries, the company reports. In actual flight, where sufficient loads can be applied, this light-weight instrument is also suited for paralleling the generators. "Voltage Only" readings can also be made. The complete instrument is self contained in a black leather carrying case.

•

Refrigerator Compressor Size Cut to One-Third

A HERMETICALLY SEALED refrigeration compressor approximately one-third the size and weight of conventional compressors has been announced by Jack & Heintz Precision Industries, Inc., Cleveland, Ohio. One-eighth and

one-sixteenth hp. units are under test now for use in 7- and 9-cu. ft. refrigerators and are expected to be available to refrigeration manufacturers later this fall. Other sizes to cover the entire air-conditioning and refrigeration fields will be announced later.

Operating at 3,600 rpm., company officials report oscillation to be nil. Despite its size, the company claims, there is no sacrifice in operating efficiency or reliability. The company states that, by use of the new compressor, a refrigerator with 9-cu. ft. storage capacity can be obtained with 7-ft. box dimensions.

•

Special Film Developed For Television Programs

A NEW 16-millimeter motion picture film has been developed for recording television programs direct from a television monitor or viewing tube, the E. I. du Pont de Nemours & Co. photo products laboratory announced recently in Wilmington, Del. The film will be used in the television industry in the

Put your mind on a BLANK!

A plastics blank, of course . . . a blank punched from BAKELITE plastic molding board that *could* be the answer to one of your supply problems.

For many manufacturers, here is an idea that might go far toward easing the present stringency in supply of molded plastic parts. For certain uses . . . particularly for flat shapes . . . BAKELITE molding board provides a shock-resistant plastic in a more workable, convenient form. It is more readily available, and it may often be substituted in whole or in part, for other types of molding plastics. For general molding requirements the material is supplied in a special "diced" or cubed form that can be pre-formed on automatic tabletting machines. Regardless of form in which supplied, these molding board plastics anchor metal inserts securely, give great impact strength to heavy duty parts and staunch reinforcement at vital points—and yet *they can be molded in general-purpose molds.* Isn't this worth discussing with your supplier?

BAKELITE phenolic resin molding boards, blanks, and diced material give high moisture resistance and excellent dimensional stability in addition to impact strength. The blanks are furnished in disk, rings, rectangles or squares in various thicknesses. A rich, glossy black is the final color.

BAKELITE'S engineers will be more than glad to consult with you and your suppliers and help you determine new ways to improve your production and extend your supplies of plastics. Write Department 76 for full information.

TRADE-MARKS

BAKELITE

MOLDING BOARDS and BLANKS

BAKELITE CORPORATION, *Unit of Union Carbide and Carbon Corporation* UCC 30 East 42nd St., New York 17, N. Y.

Put it out with GRINNELL MULSIFYRE

When such a seemingly unimportant item as a bushing failed — a transformer in an important sub-station was enveloped in blazing oil. Hose streams were inadequate to cope with the situation. Damage amounted to thousands of dollars before the fire was controlled.

Time and again it has been proved that the unusual nature of oil fires in transformers and other electrical equipment calls for more than old-fashioned fire-fighting methods. It requires the positive protection of a Grinnell Mulsifyre System – engineered to kill such fires fast!

Grinnell Mulsifyre Systems have gained wide acceptance on a proved effective principle – in which blazing oil is emulsified with a driving spray of water. The oil is turned into a liquid which is incapable of burning – the fire is extinguished in a few seconds – reignition is prevented.

There is absolutely no conductivity along the discharge of a Mulsifyre projector when spray strikes conductors carrying high voltages. Mulsifyre Systems are permanently installed – are constantly on guard when operated automatically – or may be operated manually.

Recommended by Underwriters' Laboratories for use in extinguishing fires in flammable oils immiscible in water, wherever such oil is a fire hazard – in transformers and other oil-filled electrical equipment.

Don't wait for fire to strike. Provide this 24-hour-a-day protection for your equipment from now on. Grinnell engineers will help you plan protection for your specific needs.

GRINNELL COMPANY INC.

Executive Offices, Providence 1, R. I.
Branch offices in principal cities.

GRINNELL *Mulsifyre*

AUTOMATIC FIRE PROTECTION

same way that transcriptions are now used in radio to make permanent records of programs.

It is particularly sensitive to the type of light which is given off by a monitor tube in a television studio. It is anticipated that the new film will be used for record purposes after the live action has been televised. In addition, because of the cost and technical difficulties of establishing complete television networks for simultaneous broadcasting, the new film may be adapted to the rebroadcast of programs in cities not connected to any master network.

•

Standard Base, R-40 Flood Lamp Made in 500-Watt Size

A NEW, weatherproof R40 Hi-Flood lamp has been produced by Radiant Lamp Corp., 300 Jelliff Ave., Newark 8, N. J., for indoor and outdoor lighting of displays, amusement and sports areas, service stations, parking lots. They may also be used in stores and industrial plants for both high and low bay lighting. A special heat-resisting glass eliminates the necessity of using metal reflectors, as the lamp resists thermal shocks, the company reports. This glass also makes it possible to furnish 500-watt lamps with R40 bulbs and bases which fit in ordinary fixtures. It is made with an internal reflecting surface and is available in 300- and 500-watt sizes.

•

Intercommunication Stations For High Dust, Humid Areas

NEW DUST and moisture-proof, metal-housed, industrial type intercommunication staff stations for remote and privacy operation, have recently been introduced by Executone, Inc., 415 Lexington Ave., New York 17, N. Y. They are designed for use in refrigerated rooms, laundries, shipping and receiving platforms, foundries, and all other locations where exposed to rough usage.

Equipped with a call-origination button, the remote type Model C-22 unit permits the user to receive a call and reply from a distance of 20 ft. without approaching the station. The privacy type Model C-26 has a toggle switch for call origination, assuring freedom from eavesdropping when in idle position.

One feature of these new models reported by the manufacturer is the concealed terminals built inside the cabinet. This eliminates the possibility of short circuiting and protects the terminals from the wear and heavy usage which these steel-cased stations are reported to withstand. In addition, specially designed louvres protect the

Keep Tools

Dry, Safe and Handy

With this Chance Hot Line Tool Trailer, maintenance crews have the tools they need — right on the job — dry, safe, and ready for use. This trailer is patterned after the latest model used by our Tips Tool Demonstration men who suggested many of its special features. It greatly simplifies storing, transporting, and handling hot line tools, increases maintenance crew efficiency and safety and cuts maintenance costs.

The trailer can be supplied with a complete set of tools for handling all types of hot line maintenance work or to accommodate your present equipment. It is furnished with a heater which may be plugged in when the trailer is not in the field and keeps tools dry and safe.

Check these Features: Non-mechanical, easy-to-open, waterproof top panels make tools readily accessible from both sides and automatically latch safely when in raised position. When closed, the panels can be securely locked. Double rear doors with lock-type handles provide additional accessibility to tools. Sponge rubber gaskets on all panels give snug refrigerator-door fit. Padded hooks provide convenient support to keep tools off the ground when not in use.

Trailer is built on low chassis making tools easy to reach. Low center of gravity adds to carrying safety.

Streamlined design, with wheels near center gives perfect load distribution and takes strain off towing vehicle.

Tow bars, brakes, and color to meet your requirements. Write for complete information, specifications and prices.

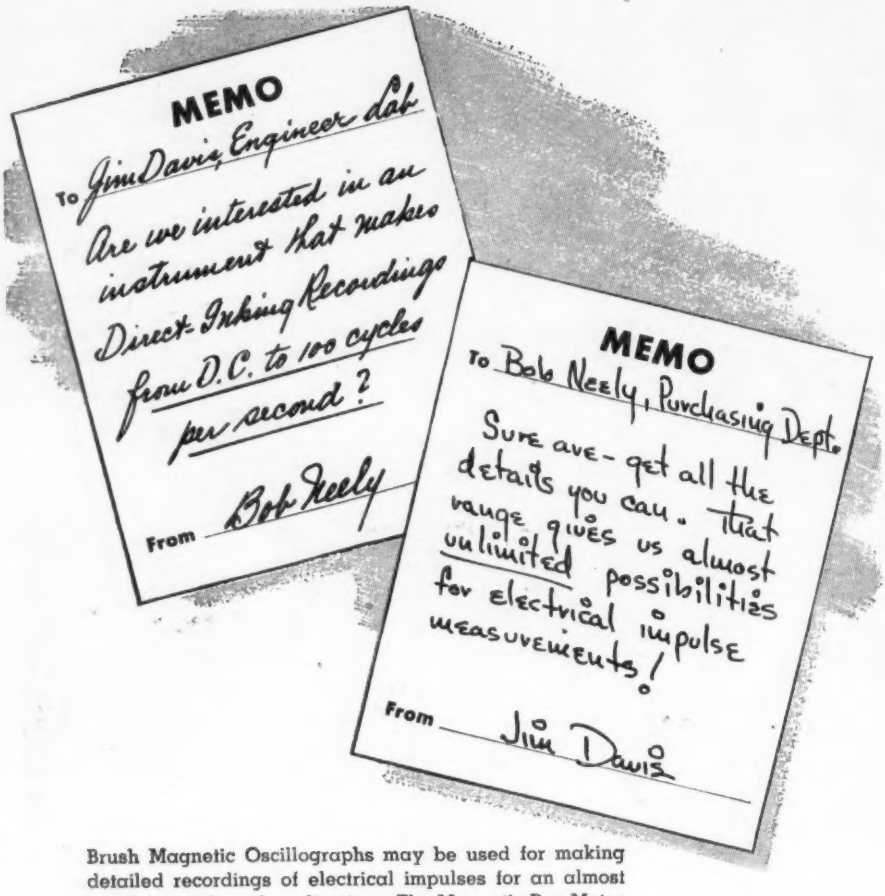
C4612

A·B·CHANCE CO·

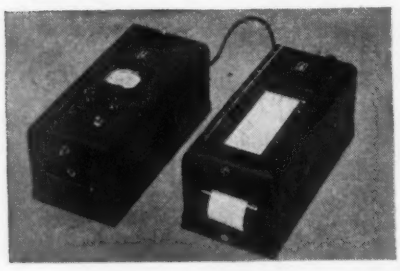
CENTRALIA, MISSOURI.

SAN FRANCISCO, CALIFORNIA

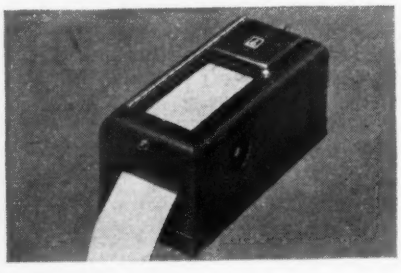
ABC INDUSTRIES


MEMO
To Jim Davis, Engineer Lab
Are we interested in an instrument that makes Direct-Inking Recordings from D.C. to 100 cycles per second?
From Bob Neely
MEMO
To Bob Neely, Purchasing Dept.
Sure ave - get all the details you can. That range gives us almost unlimited possibilities for electrical impulse measurements!
From Jim Davis

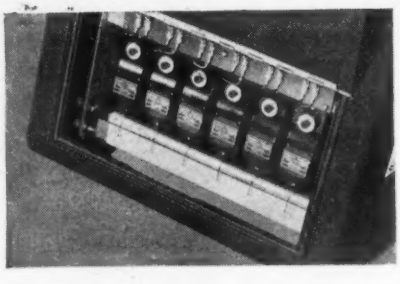
Brush Magnetic Oscillographs may be used for making detailed recordings of electrical impulses for an almost limitless number of applications. The Magnetic Pen Motor is capable of recording a D. C. signal. Used with the BL-905 amplifier, the frequency range is from .2 to 100 cycles per second. Recordings are direct, instantaneous, ink-on-paper graphs. Can be used for recording strains, pressures, vibrations, temperatures, light intensity and countless other phenomena. Write for detailed bulletin.



Brush Single-Channel Magnetic Oscillograph with amplifier. Especially suited for counting, temperature recording, surface analysis—and similar applications.



Brush Double-Channel Magnetic Oscillograph for use where two simultaneous recordings are desired—as in synchronizing problems.



Brush Six-Channel Magnetic Oscillograph. Excellent for strain-gauge recordings and similar multiple applications.

THE BRUSH DEVELOPMENT CO.

3405 PERKINS AVE. • CLEVELAND 14, OHIO

Canadian Representatives: A. C. Wickman, (Canada) Ltd.
P. O. Box 9, Station N. Toronto 14

microphone-speaker. Facilities are provided for simple wall mounting.

Designed for rigid mounting on wall or partition, these units are 6 in. wide, 6 in. high and 3 in. deep. They can be wired directly to any of the company's standard central control master stations.

•

Coupler Makes Possible FM And AM on Same Tower

BROADCASTERS may save the price of a second tower by utilizing a newly developed Iso-Coupler if erection of an FM antenna is structurally possible atop the existing AM radiator, C. F. Johnson Co., Waseca, Minn., developers of the new product, report.

It is stated that the coupler makes possible the feeding of the FM power without short-circuiting the AM radiator at its frequency or causing cross-talk at the FM frequency.

The unit is rated up to 50 kw. AM. and 10 kw. FM. It is stated to match the 50-ohm lines from the FM transmitter and not to disturb the AM tower impedance.

TECHNICAL LITERATURE

Radiant Heaters — Portable Radiant Heater Standards, publication No. 46-114, covering both rating and performance, are available from National Electrical Manufacturers Association, 155 East 44th St., New York 17, N. Y., for 30 cents per copy.

Hot Plates—Standards for Hot Plates and Disc Stoves, publication No. 46-114, are available from National Electrical Manufacturers Association, 155 East 44th St., New York 17, N. Y., for 30 cents per copy. Covers rating and performance standards as well as testing techniques.

•

New Industrial Films

How Man Made Day—A recently released film which traces man's development of light from primitive to modern times. It begins with the use of the open flame as an illuminant and depicts the advance in lighting technique through its various steps including the modern electric lamp. This one-reel sound motion picture was produced and is distributed by Coronet Instruotional Films, 919 North Michigan Ave., Chicago 2, Ill., and is available in color as well as black and white.

Golden Horizons—This film shows the development of copper-base alloys from the first discovery of copper by primitive man up to the latest techniques, and the growing importance of these alloys in present day living. The film touches briefly on the place of the producer in the metallurgical field and the importance of controlled supervision in alloying. This 16-mm. color film was produced and is being distributed by Ampco Metal, Inc., Milwaukee, Wis.

CATALOGS and BULLETINS

A monthly digest of recent manufacturers' literature compiled by Electrical World for your convenience in securing without obligation the most recent information on electrical and allied products.

CHECK ON COUPON BULLETINS DESIRED AND MAIL TO US. WE WILL FORWARD REQUESTS TO MANUFACTURERS

1 HANDHOLE SEAT GRINDER: Bulletin Y-22 describes handhole seat grinder, now available in both air-driven and electric-driven types. This machine is designed to grind handhole seats in boilers and superheaters. Illustrations and perspective drawings are shown together with a table listing width, wheel diameter and guide roller sizes used. Elliott Co.

2 CIRCUIT BREAKERS: New 201 page booklet B-3687 gives complete information, including ratings and dimensions, on the 50-amp. E Frame, the 100-amp. F Frame, the 100-amp. G Frame, the 225-amp. K Frame, and the 600-amp. L Frame breakers. It also suggests several typical arrangements for the protection of circuits and explains with the aid of diagrams the principles of thermal magnetic and thermal magnetic trip-release actions. Westinghouse Electric Corp.

3 SWITCHES & RELAYS. Circular 400 covers briefly the major items of this company's line of electrically operated switches. Complete engineering data is given. Includes discussion on automatic transfer switches, remote control switches, contactors, relays and solenoids. Illustrations and wiring diagrams are included. Automatic Switch Co.

4 SOLENOID VALVE: Bulletin 462 contains pertinent information on a new V5-100 solenoid valve which operates at pressures up to 150 psi. The valve features soft seats. To prevent possible oxidation or corrosion, parts coming in contact with the media are made of stainless steel. Sectional drawings, mounting diagrams and detailed specifications are included. Allied Control Valve Co.

5 PLASTICS FOR LIGHT CONDITIONING: A 12-page booklet describes and illustrates the uses of plastics for reflectors and shades. These plastic lighting reflectors and shades are made of specially developed plastic materials. General Electric Co.

6 ELECTRIC APPLIANCES: Three bulletins feature electric appliances. The first bulletin describes and illustrates portable electric stoves. Several types are discussed. The second bulletin covers electric washers and ironers. Standard features of each type are reviewed. Cutaway pictures show construction details. The third bulletin discusses several models of electric ranges. Construction details and specifications for each model are also given. Landers, Frary & Clark.

7 BATTERIES: Catalog 200 contains 20 pages of material on batteries designed for mine locomotive service. Interesting technical data are given in the front portion of the catalog covering the material and manufacturing processes used to make these batteries. Cutaway drawings of batteries show important details. Installation dimensions are also given together with tables to show over-all height of assembled batteries. Gould Storage Battery Corp.

8 FLUORESCENT LIGHTING: Bulletin 30A-6 features a variety of engineered lighting jobs. Several types of luminaires are discussed, showing where each type is applicable. Illustrations and construction drawings are given. Technical data is also supplied. Day-Brite Lighting, Inc.

9 ELECTRIC HEATERS, CONTROLS AND ACCESSORIES: Bulletins 16, 17 and 18 respectively all deal with electric heating systems for industrial application. Bulletin 16 features custom-built automatic controls for electric heating systems. Bulletin 17 gives a detailed discussion to electric steam and hot water boilers used in the industrial processing fields. Bulletin 18 covers a variety of industrial electric heaters for air-ducts and ovens. Illustrations are included. Hynes Electric Heating Co.

10 AIR CONDITIONING: Bulletin features an air-conditioning unit designed for general office, hospital, drug store, shoe store, grocery store, specialty shop, restaurant, professional office, and hotel installation. These air-conditioning units come in 3- and 5-hp. capacities. Cutaway view in color reveals the mechanical features of unit. Chrysler-Airtemp.

11 GERMICIDAL FIXTURE: Folder describes and illustrates a germicidal lighting fixture designed for protection of poultry and animals.. Great portion of text is devoted to a technical discussion on radiation and Angstrom units. Developed for installation in brooder houses, in incubators, dairy barns, tables,

Circle numbers, sign and mail — *Coupon good until December 31, 1946, only*

October 12, 1946

ELECTRICAL WORLD
330 West 42nd Street, New York 18, N. Y.

Please send me, without obligation, manufacturers' literature herein described and identified by numbers circled below:

1	2	3	4	5	6	7	8	9	10	11	12	13	14
15	16	17	18	19	20	21	22	23	24	25	26	27	28
29	30	31	32	33	34	35	36	37	38				

This coupon, properly filled in, is referred to the manufacturers for handling. Electrical World serves as a clearing house for this service.

NAME ..... TITLE .....

COMPANY .....

ADDRESS .....

CITY ..... STATE .....

A MUST IN EVERY LAB . . .
ON EVERY SERVICEMAN'S BENCH . . .
IN EVERY SERVICE KIT . . .

A pocket-size

OSCILLOSCOPE

The **POCKETSCOPE**

A 2" "pocket-size" 'scope incorporating the cathode ray tube, vertical and horizontal amplifiers, linear time base oscillator, synchronization means and self-contained power supply.

• So **SMALL** in size (4" x 6⅜" x 10") • So **LIGHT** in weight (5¾ lbs.) • So **COMPLETE** in performance • So **INEXPENSIVE** in price • Plus **WIDE-ANGLE VISION:** on shelf, on floor, on bench • Plus **RETRACTABLE LIGHT SHIELD:** for increased visibility.

FOR DELIVERY:

Contact your nearest jobber. If he doesn't have the POCKETSCOPE available, contact us direct.

WATERMAN PRODUCTS

WATERMAN PRODUCTS CO.
INCORPORATED
PHILADELPHIA 25, PENNSYLVANIA

Specified ON IMPORTANT INSTALLATIONS . . .

Impressed on Each Piece of Victor Porcelain THIS SYMBOL OF QUALITY

V

• High tension porcelain insulators made at Victor have passed the most severe tests on various types of installations during the past 50 years. For safety, long service and satisfaction in high voltage insulators, look to Victor.

THE MARK OF ENDURING SERVICE

SEND FOR FREE BOOK
"A Story of Victor" tells how insulators are made. 24 pages. Write for a copy.

VICTOR INSULATORS, Inc.
VICTOR, NEW YORK

etc. Illustrations of fixtures are shown. Tru-Air Ultra-violet Products Co.

12 CABLE JOINTS: Bulletin CJ2 is a second of a series of bulletins on various types of cable joints. Covers straight two-way cable joints for three conductor shielded type, varnished-cambric, lead covered cables. Includes cable joint design drawings and construction data, description of the materials recommended, instructions for making cable joints, directions for specifying and ordering jointing material in unit packages. G & W Electric Specialty Co.

13 OUTLETS & BOXES: Bulletin 72 covers a variety of electrical outlets and floor boxes designed for all purposes. Illustrations shown in perspective and in color are given together with pertinent technical information covering each type of equipment. Cutaway views of product show inside construction details. Frank Adam Electric Co.

14 HAND TACHOMETERS: Featured in this circular is a new line of hand tachometers for indicating speeds in rpm. or fpm. in clockwise or counterclockwise rotation. O. Zernickow Co.

15 BATTERY-CHARGING EQUIPMENT: Bulletin 205 illustrates and describes motor-generator battery-charging equipment for "on-the-spot" charging of motorized lift truck batteries. Unit includes motor-generator, control panel and protective devices. Tables given for charging 6-cell and 10-cell batteries. The Electric Products Co.

16 CONTROLS: Catalog 145-A contains a varity of floatless liquid level controls for use on general purpose pumps, condensate return pumps, metering supply to tanks, water pans on humidifiers, etc. Prices and specifications are given for each type of control discussed. Includes also illustrations, dimensional and application diagrams. B/W Controller Corp.

17 FLUORESCENT LIGHTING FIXTURES: Bulletin 75 features a variety of all-steel fluorescent fixtures designed for industrial and commercial use. Engineering features are discussed. Illustrations and tables giving lamp size, reflector type, number of lamps, voltage, over-all dimensions are furnished. Computed illumination tables are also included. Wheeler Reflector Co.

18 RECTIFIERS: Bulletin RDP104 lists several models of portable high rate rectifiers for emergency battery charging and general signal shop use. Illustrations, circuit diagrams, tables, and technical description of equipment are included. Fansteel Metallurgical Corp.

19 WELDING LENSES: Catalog AWP-21 features a line of welding lenses for goggles, helmets and handshields. Gives complete descriptions as well as photographs of welders' lens and industrial safety lenses for chipping and grinding operations. Eastern Equipment Co., Inc.

20 CARBON - GRAPHITE PRODUCTS: Booklet, containing more than 40 pages of text on carbon-graphite products, gives characteristics and a few typical applications of this material. Mechanical, electrical, and chemical properties are discussed. Cutaway views of equipment in

Super

NON-INDUCTIVE RESISTORS

FOR HIGH R-F USES

Sprague Koolohm type SIF super non-inductive resistors have solved many serious problems in high-frequency radar and communications work involving dummy loads and dummy antennae, line terminations, rhombic antenna phasing resistors, and others—wherever there is need for power wire-wound resistors having extremely small phase angles.

These SIF units are made in seven types, with power rating from 15 to 150 watts. Typical maximum phase angle values, measured at 3MC are as follows:

5 ohms to 26 ohms . . . 20°
27 ohms to 99 ohms . . . 12°
100 ohms and higher . . . 6°

For complete details write for the new catalog of Sprague Koolohm wire-wound resistors for every requirement.

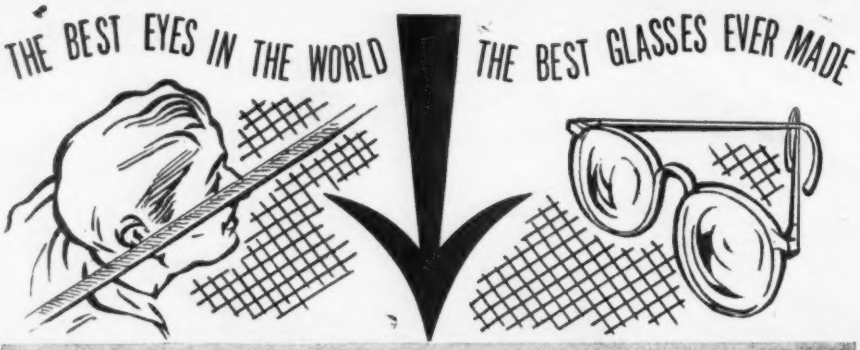
A Large Government Laboratory Reports:

"Preliminary measurements on the Sample No. 878, Type 120SIF resistors have indicated that these resistors should fulfill the requirements of the intended service. Over a frequency range from 6 to 15 Mc and with six units connected in parallel the impedance (R±JX) varied from 49+J4.3 to 51+J6.3. At a frequency of 10 Mc and with each unit measured singly, the resistance of six units varied from 295 to 306.5 ohms and the reactance varied from 0 to −4.2 ohms. The higher reactance obtained for the parallel arrangement is partially due to the necessary connecting buss bars."

SPRAGUE ELECTRIC COMPANY
RESISTOR DIVISION NORTH ADAMS, MASS.

SPRAGUE KOOLOHM RESISTORS
Reg. U. S. Pat. Off.

WIRE-WOUND POWER TYPES • BOBBIN TYPES • METER MULTIPLIERS • MEGOMAX, ETC.



. . . are not good enough to detect tension and sag to TODAY'S standards!

Be CERTAIN with a Dillon DYNAMOMETER

Quickly gives you exact readings. Takes out all guessing. SAVES TIME. Saves maintenance. Up-to-the-minute telephone men are using Dillon Dynamometers for guys, conductor, strand or high tension wire. Large easily read figures in pounds, instantly read. No charts. No figuring. Compact, easily carried. Nine capacities for 500 to 20,000 lbs., all same size.

Wire, write or phone for illustrated folder with full details.

Weight: 8 lbs., 4oz. Size 8¼" x 6¼" x 3". Not injured by overload. Strong construction cased for all weathers

W. C. DILLON & CO. Inc.

5410 W. Harrison St., Chicago, Ill.

IMPORTANT News FOR INDUSTRY

2 new LOW-TEMPERATURE SILVER BRAZING ALLOYS

EASY-FLO 45 AND EASY-FLO 35

NEW LOW BRAZING TEMPERATURES SILVER CONTENTS BRAZING COSTS

Already widely approved by manufacturers in many fields. Find out how much these new alloys will speed up your metal joining and cut costs. Write for a free demonstration—or place a trial order with your regular supplier and TRY THEM in your own shop.

HANDY & HARMAN

82 FULTON ST., NEW YORK 7, N. Y.

Bridgeport, Conn. • Chicago, Ill. • Los Angeles, Cal. • Providence, R. I. • Toronto, Canada

Agents in Principal Cities

which carbon-graphite products are used, are shown. The United States Graphite Co.

21 STRESS ANALYSIS: A pamphlet, "Photoelastic Stress Analysis," provides engineers and scientific investigators with a survey of the general photographic aspects of photoelastic stress analysis. Pamphlet gives background information and basic working specifications for this technique. Covers such subjects as the optical theory, apparatus, the model, photographic materials, analysis of the records obtained, and three-dimensional analysis. Eastman Kodak Co.

22 ADJUSTABLE LIGHTING UNITS: Catalog 45 features a variety of adjustable lighting units designed for critical work on machines, benches, tables, etc., requiring high levels of illumination. Construction features of each model are discussed. Specifications and accessory equipment are also given. The Fostoria Pressed Steel Corp.

23 GENERATOR OILS: Several bulletins given here cover the purification of turbine and hydroelectric generator oils. Information deals with causes of oil failures. One bulletin is devoted to the discussion on the purification of insulating oil. Another bulletin gives in graph form coefficient of expansion of petroleum oils. Honan-Crane Corp.

24 CURRENT TRANSFORMERS: Bulletin 87 describes and illustrates a bushing-type current transformer designed for use with standard watthour meters and wattmeters having a nominal secondary current of 5 amp. Vector diagrams of currents are given as well as magnetization curves. Pacific Electric Mfg. Corp.

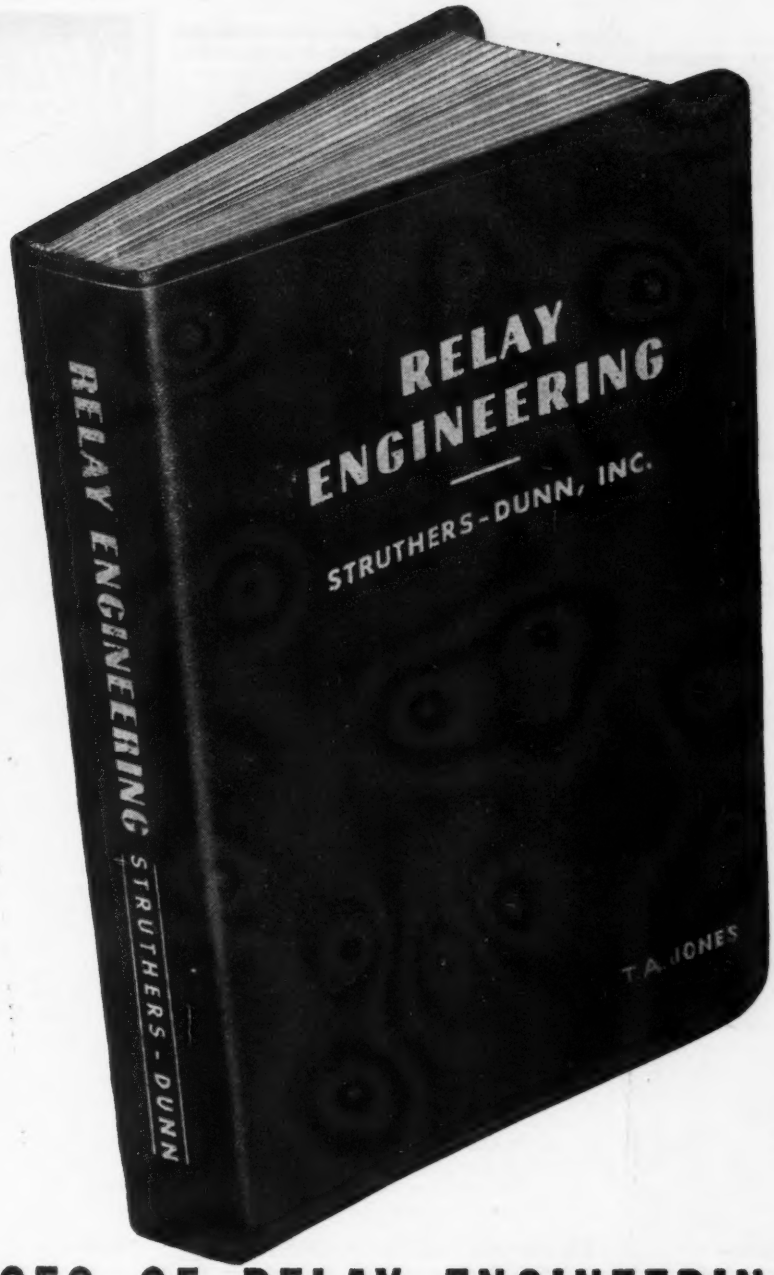
25 FIRE EXTINGUISHING SYSTEMS: Folder identified as file number S-63 discusses fire extinguishing systems engineered for specific hazards. Provides a typical example from a transformer fire. Systems can be adapted to industrial plants as well as public utility properties. Cardox Corp.

26 LIGHTING: Bulletin 10-B-1 features continuous installations of fluorescent lighting systems, used for general offices and commercial establishments. Servicing, mounting and wiring data are given. Tables covering method of figuring foot-candle intensities are also given. Day-Brite Lighting, Inc.

27 ELECTRICAL CONNECTORS: A detailed technical section of a catalog contains 28 pages of tables, formulas and other information on electrical connectors. Catalog describes this manufacturer's complete line, giving dimensions, shipping weights, etc. Anderson Brass Works, Inc.

28 MOTORS: Bulletin 1160 describes and illustrates a line of motors manufactured by this company. Motors are stripped, showing how each component is manufactured. Construction drawings are given, showing dimensions. Tables are included giving frame sizes. Last page of bulletin is devoted to motor characteristics. Fairbanks, Morse & Co.

29 SPECTROMETERS: This 4-page booklet R 1022 describes the principles of operation of the Geiger-Counter X-ray spectrometer. Tells how the instrument is



640 PAGES OF RELAY ENGINEERING INFORMATION... *Have you gotten your copy?*

Price $3.00

STRUTHERS-DUNN, INC., 1321 ARCH STREET
PHILADELPHIA 7, PA.

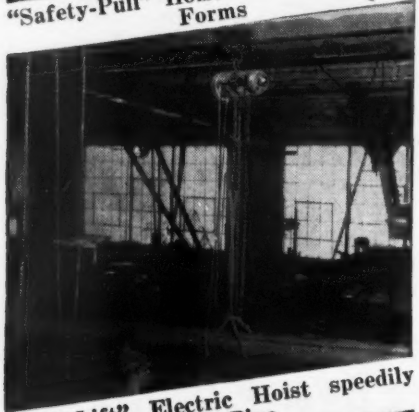
STRUTHERS-DUNN

5,327 RELAY TYPES

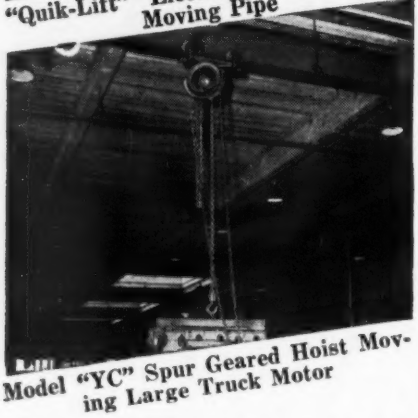
ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DALLAS
DENVER • DETROIT • HARTFORD • INDIANAPOLIS • LOS ANGELES • MINNEAPOLIS • MONTREAL
NEW YORK • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO

Wherever COFFING HOISTS are installed there is a noticeable saving in manhours and manpower. New uses are being found daily in all kinds of plants and industry—whether it's production, construction or maintenance.

"Safety-Pull" Hoist Pulling Concrete Forms



"Quik-Lift" Electric Hoist speedily Moving Pipe



Model "YC" Spur Geared Hoist Moving Large Truck Motor

There is a COFFING HOIST to meet your requirements. Contact your supply house for detailed information or write for our Bulletin Form E 4.

COFFING HOIST COMPANY
Danville, Illinois, U. S. A.

being used for control of cemented-carbide products. Data is presented to show how analysis time has been reduced. Illustrations, photographs and two spectrometer charts are given. North American Philips Co., Inc.

30 RELAYS & TIMING DEVICES: Catalog contains 24 pages of illustrated, practical information on relays and electrical timing devices. Full data on applications, selection and capacities complete with each model are given. Potter & Brumfield Sales Co.

31 GENERATORS: Bulletin describes a number of generator units designed to meet individual needs. Sizes of generators are listed and technical details given. Kato Engineering Co.

32 ADJUSTABLE LIGHTING UNITS: Bulletin describes and illustrates units designed for localized lighting. Discussion on the proper use of these units is given, showing how maximum lighting results can be obtained. The Fostoria Pressed Steel Corp.

33 CONTROL DEVICES: Bulletin 74 covers a selection of electrical control equipment used for modern stage switchboards. This equipment includes use of electronic controls. Other applications are given, together with illustrations and specifications. Ward Leonard Electric Co.

34 OFFICE & SCHOOLROOM LIGHTING: Two new brochures discuss lighting of schoolrooms and offices, incorporating the creative ideas of leading architects in these fields. Illustrations printed in color show features of modern office and schoolroom lighting. General Electric Co.

35 HYDRAULIC JACKS: Bulletin 1040D describes and illustrates all the various models and types of ratchet, screw and hydraulic jacks designed to facilitate moving and leveling equipment weighing up to 75 tons. Included are models with transverse bases for placing under equipment. Technical data and specifications are given. The Buda Co.

36 CABLE CONNECTIONS: A 9-page bulletin features tools and accessory equipment required on a welding cable, both electrode and ground, to mechanically hold and electrically transmit current from the welding machine to the point of deposition. Illustrations and cutaway views of connections are shown, together with specifications. Tweco Products Co.

37 ADEQUATE WIRING: A 20-page electrical modernization guide points out what is wrong with the wiring in homes today and what can be done to bring home wiring up-to-date. Guide is illustrated, gives diagrams of house wiring systems, a table summary of required outlets, etc. General Electric Co.

38 RAILROAD LIGHTING: Eight-page brochure Y-610 is designed to acquaint railroads with the countless advantages resulting from better lighting. Illustrations are used to show special lighting applications employing modern lighting to improve railroad service. Illumination for passenger cars, waiting rooms, platforms, classification yards, control panels, locomotives, baggage cars and signal systems is also discussed and illustrated. General Electric Co.

Silicone News

DC SILICONES

Is DC 996 the key to the market for air cooled transformers?

When transformer coils look like this after 6 months of service, there is a place for heat-resistant Silicone Insulation in air-cooled transformers. Certainly an eager market awaits a serviceable, lightweight transformer. Electrical engineers are now working to supply that market with transformers insulated with inorganic materials impregnated with DC 996.

The added heat resistance of DC 996 offers a potential reduction of 30% to 50% in size and weight compared with other air-cooled transformers and up to 75% reduction compared with oil-filled transformers of equal capacity. Increased reliability due to the greater moisture-proofness, thermal stability, and chemical resistance of DC 996 is another advantage. Important also is the virtual elimination of fire hazard.

Preliminary testing of Silicone insulated transformers indicates that by proper design, performance characteristics can be kept within the limits specified for larger and heavier transformers built with conventional materials.

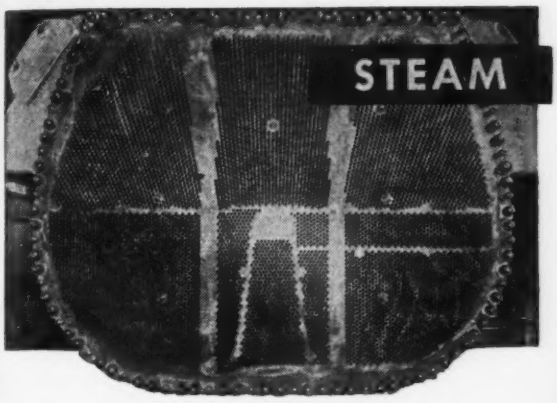
Recommended procedures for applying DC 996 are available in leaflet No. L 3-1.

SILICONE GREASES—Essential to the higher operating temperatures made possible by Silicone Insulation, and for bearings of machinery in hot locations are high temperature silicone greases. One application of DC 44 was effective for 5¼ months of continuous operation at 125° C. (257° F.) in the bearings of a 7½ h.p., 1750 r.p.m., 440-volt silicone insulated induction motor. Data Sheet No. L 7-1 contains additional information about Dow Corning Silicone Greases.

DOW CORNING CORPORATION
MIDLAND, MICHIGAN

Chicago Office: Builders' Building
Cleveland Office: Terminal Tower
New York Office: Empire State Building
In Canada: Dow Corning Products Distributed by Fiberglas Canada, Ltd., Toronto

Dow Corning
FIRST IN SILICONES



MAIN CONDENSER for a U. S. Navy Carrier, equipped with tubes and tube sheets of Anaconda Super-Nickel, 7526 tubes used in each of the main condensers.

REFRIGERATING CONDENSER built by Carrier Corporation, Syracuse, N.Y. Tubes and tube sheets are Anaconda Super-Nickel, with outside shell of Brass.

LUBE OIL COOLER tube bundle fabricated by Ross Heater & Mfg. Co., Inc., Buffalo, N. Y. Equipped with Anaconda Super-Nickel Tubes and Tube Sheets, with Anaconda Brass baffles.

All three

Equipped with Super-Nickel Alloy Tubes

DURING MANY YEARS of specialized experience, The American Brass Company has developed a range of tube and sheet alloys which fills practically every condenser or heat exchanger requirement.

The accompanying photographs show three different applications, each of which utilizes Anaconda Super-Nickel Alloy Tubes and Sheets.

A pioneer in the development of this unusually corrosion-resistant alloy, The American Brass Company was first to install special tube making equipment for the extruded-rolled-and-drawn process.

Eleven other standard and several special alloys are now produced for condenser and heat exchanger service. For assistance in selecting the one best suited to your needs, consult our Technical Department, or send for Publication B-2.

ANACONDA

Anaconda

CONDENSER TUBES

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company

In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

NEWS ABOUT PEOPLE

J-M Elects New Officers; R. W. Lea Made President

Johns-Manville Corp. has announced the election of Lewis H. Brown, who has been president since 1929, to be chairman of the board and chief executive officer of the company.

R. W. Lea, who has been vice-president for finance since 1939 and executive vice-president since January, 1946, was elected president; Alvin Brown to be vice-president for finance and a member of the board of directors and John P. Syme to be vice-president and assistant to the chairman of the board.

R. W. Lea

Under this delegation of responsibility, the chairman of the board will devote himself to general policy, the growth of the company and external relations, while the new president will be responsible to the chairman for administration, current operations and internal relations. Reorganization of the company into six operating divisions accompanied the major realignment of responsibilities. Each of the newly created operating divisions will be responsible for production and sales of the products under its respective responsibility.

Mr. Lea, the new president, announced appointment of general managers of these six operating divisions as follows: J. A. O'Brien, industrial products division; Harold R. Berlin, building products; A. S. Elsenbast, celite, and E. C. Brockett, Canadian products. E. S. Crosby continues as general manager of the international division and A. R. Fisher, who is vice-president for production, will act as general manager of the asbestos fibre division. All have been members of the Johns-Manville organization for many years.

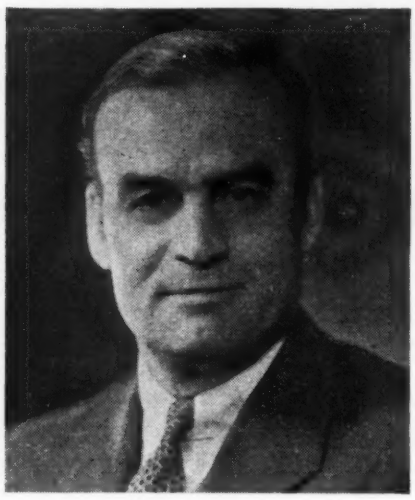
Mr. Brown joined J-M in 1927 as assistant to the president, and two years later, at the age of 35, he became president.

Mr. Lea, besides being executive vice-president, has been a director of the company since 1940. In addition to his other duties, Mr. Lea directed the subsidiary which operated the Kansas Ordnance Plant during World War II. He became identified with Johns-Manville as vice-president for finance in 1939 after serving as president of the West Virginia Coal & Coke Co.

•

Lincoln Elects C. M. Taylor Executive Vice-President

C. M. Taylor has been elected executive vice-president of the Lincoln Electric Co., Cleveland, Ohio. Mr. Taylor has been connected with the Lincoln organization continuously since 1916, with the exception of the period he spent in military service in World War I. Returning at the end of the war, he became a foreman, later was placed in charge of the company's time study and methods department, advanced to assistant superintendent and then superintendent.



C. M. Taylor

In 1928 Mr. Taylor was appointed vice-president in charge of sales and has served as a director since 1927.

A. P. Good Retires From Commonwealth Edison Co.

Arthur P. Good, superintendent of Commonwealth Edison Co.'s meter department, has retired from active duty after completing 44 years of service. Mr. Good is nationally known for his contributions to the promotion of improved wiring methods and the development of modern electrical codes.

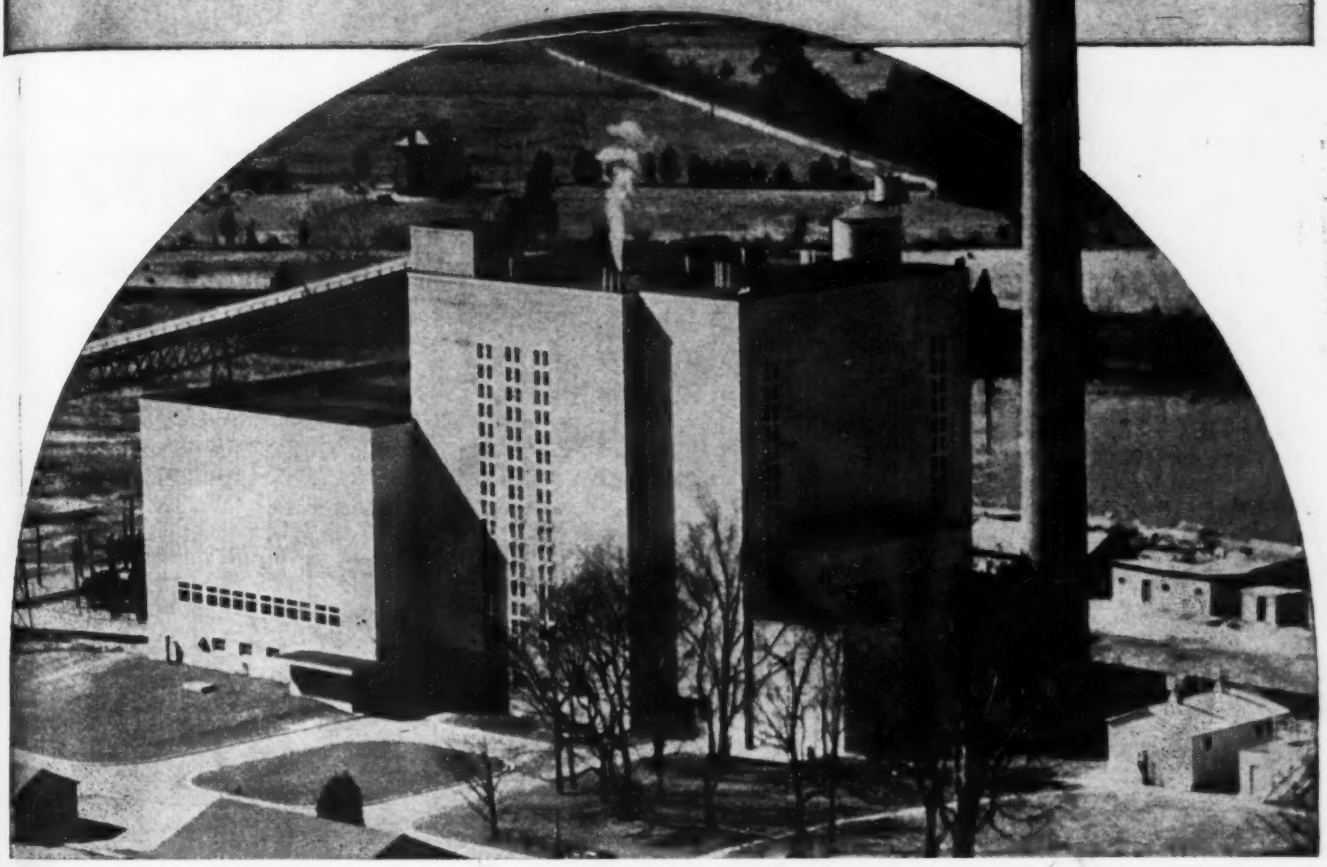
Starting his career with the Chicago utility as a meter inspector while still in his 'teens, Mr. Good later became a meter tester, repairman and wiring inspector. He was advanced to chief inspector, assistant superintendent of the meter department and to superintendent in 1934.

A. P. Good

Twice chairman of the National Electric Light Association wiring committee and twice chairman of the committee on metering and service methods for the Association of Edison Illuminating Companies, Mr. Good was also a member of the electrical committee of the National Fire Protection Association, which sponsors the National Electrical Code. He has headed six N.F.P.A. subcommittees and served on five others and was delegated to take part in the National Industry Conference on Wiring in 1927.

Mr. Good represented Commonwealth Edison Co. as a cooperating member of the International Association of Electrical Inspectors. On several occasions he has served on the executive committee of its Western Section and he has been chairman or member of five

TURNING DEMAND INTO SUPPLY



Chesterfield Station, Virginia Electric & Power Company, near Richmond, designed and constructed by Stone & Webster Engineering Corporation. Another new power plant for this client is now in the design stage.

Because of the necessary curtailment of normal power plant construction during the War, the nation's utilities and industrial plants must now increase their power generating capacity to meet the growing needs of peacetime production.

New steam and electric generating facilities and plant extensions, using turbine units ranging from 1,500 to 80,000 KW and boilers ranging from 20,000 to 650,000 pounds of steam per hour, now on the design boards of Stone & Webster Engineering Corporation, will have a total capacity of 673,500 KW and 10,300,000 pounds of steam per hour.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

THE IMC ENGINEER IS
On Your Staff-

The IMC Engineer is, in effect, traveling companion to IMC products. He provides "experience at work" to insure insulation that approaches perfection. He's always ready to . . .

1. Assist you in the selection of the best insulating material for your job.
2. Familiarize you with the proper application.
3. Suggest ways to eliminate waste.
4. Help increase your production.

Complete insulation service from one source.

Full line of nationally recognized products.

Fabricating facilities to supply your needs.

"Know-how" engineers...strategically located.

Prompt shipment from complete stocks.

INSULATION
MANUFACTURERS CORPORATION

ELECTRICAL IMC INSULATION

*CHICAGO 6, 565 W. Washington Blvd.

*CLEVELAND 14 1231 Superior Ave., N. E.

Branches in: MILWAUKEE 2: 312 East Wisconsin Ave.; DETROIT 2: 11341 Woodward Avenue; MINNEAPOLIS 3: 1208 Harmon Place; PEORIA 5: 101 Heinz Court; and other cities.

I.A.E.I. committees. He was a member of the Electrical Commission of the City of Chicago and is the author of the section "Wiring of Buildings and Industrial Plants," in the sixth edition of Fowle's "Standard Handbook for Electrical Engineer."

•

Alabama Power Announces Engineering Appointments

Four promotions affecting the Mobile district have been announced by Alabama Power Co. with the advancement

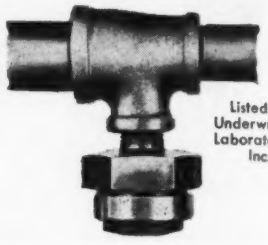
R. E. Pride

of R. E. Pride as superintendent of the district, a newly created position.

Thomas M. Hand has been promoted to district superintendent of the Atmore district to succeed L. J. Collins, who returns to Mobile as district engineer. Mr. Collins succeeds H. J. Gregory, who has been promoted to superintendent of local operations at Mobile to fill the vacancy created by Mr. Price's promotion.

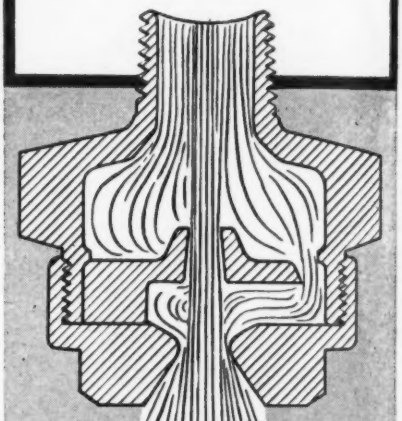
Mr. Pride, who until recently was superintendent of local operations for the Mobile Division, joined the company in 1926 as a helper in one of the construction crews of the Dixie Construction Co., which at that time handled construction work for Alabama Power. In 1929 he was transferred to the Mobile Division.

Mr. Hand joined the company in 1934 at Mobile. In 1936 he was transferred to Birmingham, thence to Mobile as distribution engineer, where he remained until 1942 when he entered military service. He returned to the company last June at Atmore as district superintendent. Mr. Gregory, who joined the company in 1926, has recently returned from military service. Mr. Collins joined Alabama Power in 1935 as plant operator at Citronelle. A year later he was transferred to Mobile and became distribution engineer in 1940. Since returning from military



Listed by Underwriters Laboratories, Inc.

This is how the
BLAW-KNOX
Aquatomic
FOG NOZZLE
FIGHTS FIRE



IN TRANSFORMERS, FLAMMABLE LIQUIDS AND STORAGE TANKS

The *Aquatomic Fog Nozzle* creates a cone of atomized water particles having force enough to reach to the base of the fire in spite of air turbulence and drafts.

At the same time, these particles are fine enough to give a maximum cooling and quenching effect, and are so well separated as to prevent conduction of electric currents.

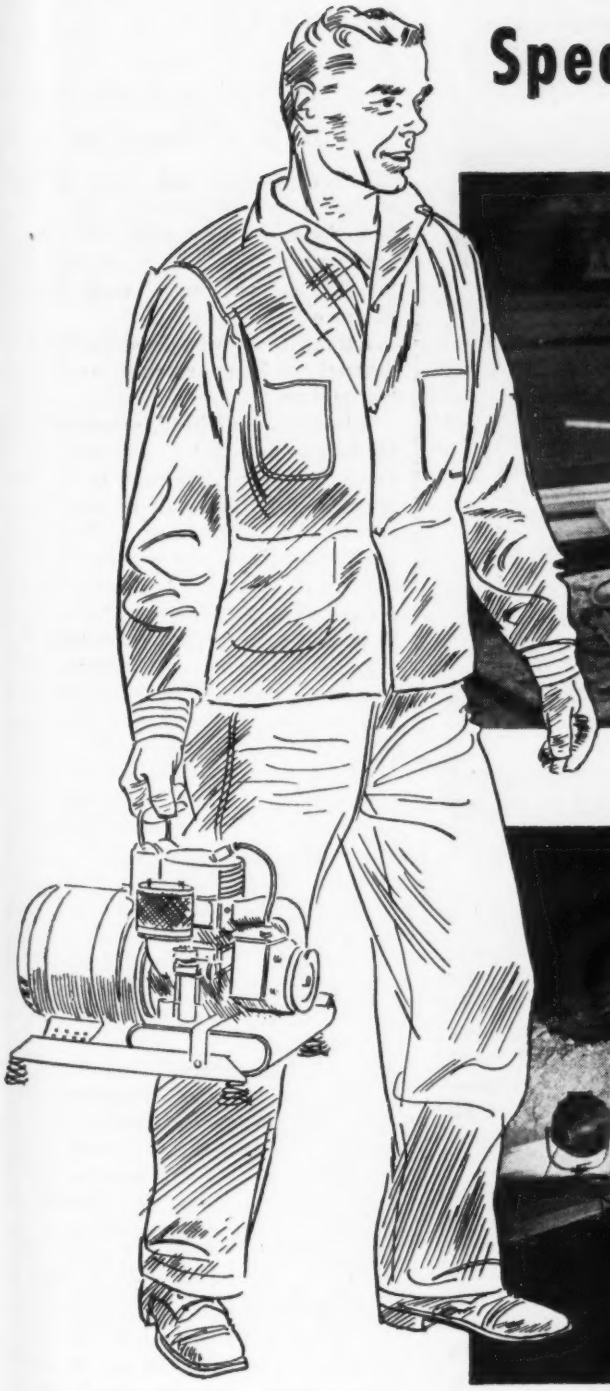
The spray pattern is maintained even with reduced pressures. Clear passages in the nozzle prevent clogging.

Also—
Standard Wet and Dry Pipe Systems, as well as Thermostatically Controlled Pre-Action and Deluge Systems.

Write for details

BLAW-KNOX
SPRINKLER DIVISION
829 Beaver Avenue, N. S.,
Pittsburgh 12, Penna.

Their Performance Speaks Louder Than Words



Above — A Homelite Generator on the job furnishes plenty of power to operate time-saving electric saws.

Below — A Homelite Pump and Generator make the right combination for speeding dewatering jobs at night.

We'd much rather show you Homelite Portable Gasoline-Engine-Driven Pumps and Generators *in action* than just talk about them. Action speaks louder than words.

So why not let us give you a free demonstration . . . any place you want it. See how fast a Homelite pumps, how quickly it primes itself, how easily it handles heavy liquids and solids. See all the cost-cutting operations you can put to good use on day or night work with steady electric power furnished by a handy Homelite Generator.

To get such a demonstration, free from all obligations, simply write. We'll have our nearest representative get in touch with you.

Homelite
CORPORATION
Port Chester, New York
Portable Pumps Generators and Blowers
GASOLINE-ENGINE-DRIVEN

with *COLOVOLT

COLD CATHODE • LOW VOLTAGE LIGHTING

For greater customer satisfaction.

Lower maintenance cost — longer maintenance of a given foot-candle level—greater dependability because of guarantee (One year of light guaranteed except for failure due to breakage)—instantaneous starting—no flickering — continuous line lighting. These extra advantages are available to commercial and industrial users of light when installations are made with COLOVOLT Cold Cathode, Low Voltage Fluorescent Lamps and Fixtures.

Write for illustrated material and technical data.

*Trade Mark Registered U. S. Patent Office

General LUMINESCENT CORPORATION

GENERAL LUMINESCENT CORPORATION

660 S. FEDERAL STREET CHICAGO 5, ILLINOIS

Specify

ADVANCE BALLASTS

FOR UNEXCELLED PERFORMANCE

Leading manufacturers of lighting fixtures use and recommend "ADVANCE" Ballasts for QUIET operation, high efficiency performance, low replacement cost and long life. "ADVANCE" Ballasts are streamlined for easy installation in fixtures and are approved by Underwriters Laboratories.

ADVANCE TRANSFORMER CO.

Cable Address: ADTRANS

1148 W Catalpa Ave. Chicago 40, Ill., U. S. A.

service, he has been senior district engineer at Mobile, district superintendent at Atmore and senior district engineer, again at Mobile.

•

Colleges Turn to Industry to Rebuild Teaching Staffs

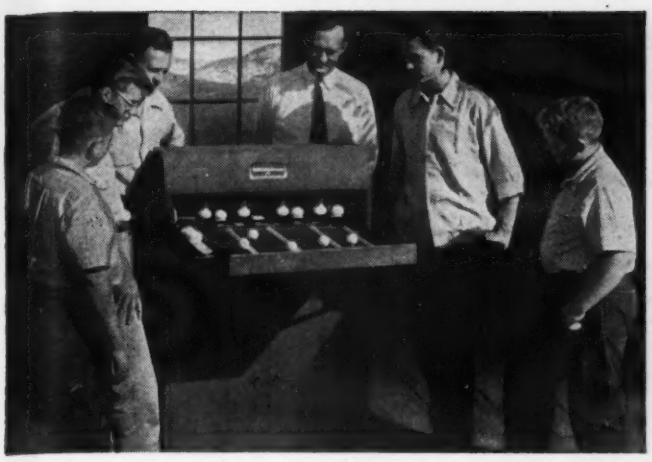
Engineering schools and colleges which in the early years of the war lost their teaching staffs to industry are turning to industry to rebuild their faculties as enrollments break all previous records.

Among those who have resigned industrial positions recently to become teachers are:

Edwin R. Whitehead, associated with the Duquesne Light Co. for the past 14 years, has been appointed to the electrical engineering staff of the Illinois Institute of Technology. Dr. Whitehead will assume the position formerly held by Dr. William A. Lewis, who was appointed dean of the graduate school of Illinois Institute of Technology. During his association with Duquesne as research supervisor, operating engineer, investigating engineer, and general engineer, he conducted several surveys on lightning protective devices that led to the development and patenting of a self-contained instrument for counting the number of discharges through such devices. In addition, he developed a very sensitive system for automatic paralleling of separated power systems at precisely the correct instant. He also contributed to the development of system studies with the a. c. network calculator.

Dr. Ralston Russell, Jr., director of ceramic research for Westinghouse Electric Corp., East Pittsburgh, Pa., has joined the Ohio State University staff as professor of ceramic engineering. An Ohio State alumnus, Dr. Russell was for three years ceramic engineer with the AC Spark Plug Co. at Flint, Mich.; another year he was with the General Ceramics Co. at Keasbey, N. J., and since 1940 has been on the Westinghouse staff. In recent months Dr. Russell has inspected ceramic plants in Germany and other European countries on a technical mission for the U. S. government.

Dr. G. D. McCann, consulting transmission engineer with Westinghouse Electric Corp., is returning as associate professor of electrical engineering to California Institute of Technology, from which he received his doctorate in 1939, his degree of master of science in 1935, and his degree of bachelor of science in electrical engineering in 1934. Since school days, Dr. McCann has been interested in lightning. With Charles F. Wagner, manager of the Westinghouse central station engineer-



JOE COX, County Club Agent, discusses the merits of an electrically operated egg grader with C. H. Winjum, representative of the Portland General Electric Company, and a group of boys from a local 4-H Club.

ED L. SHANNON, Portland 4-H Club Agent, and interested 4-H members listen to an explanation of the Better farm-and-home Methods Guide Book given by Jim Goggin, public relations representative of Portland General Electric Company.

YOU, too, can participate in this Program . . .

Do as scores of progressive utilities are now doing—by tying-in your rural activities with this National Program that is *right now* operating in your territory. There is nothing for you to *develop* or *originate* to identify your organization with the Better Methods Electric Contest.

FREE...everything you need for promoting your own Better Methods Electric Program

GUIDE BOOK — Explains Better Methods and how to apply them in simple, understandable language. Packed with factual information on farm and home jobs and chores.

REPORT FOLDER — Contains convenient blank forms for 4-H Club members to develop and report their Better Methods Electric Projects.

LEAFLET — A complete explanation of each step of the Contest, also rules and regulations . . . for distribution to 4-H Club boys and girls.

POSTER — For display in your showroom windows in your farm territory —to establish them as information stations on the Electric Contest.

FARM BULLETINS — Twelve Bulletins on the many and varied uses of electricity on the farm and in the farm home.

IDEAS — Many useful suggestions to help you conduct your locally-sponsored Better Methods Electric Program.

Now's the time to get started for 1947

Begin, *now*, to plan your Better Methods Electric Program for 1947 — so you will be ready to go *early next year*. Send for the portfolio: "A Rural Community Service Program." In it you will find samples of the free material described above, and other helpful information. *Contact your nearest Westinghouse office — or mail coupon.*

Tune in: TED MALONE — Monday, Wednesday and Friday, 11:45 am, EST, American Network.

Westinghouse
PLANTS IN 25 CITIES OFFICES EVERYWHERE

MAIL COUPON TODAY!

Rural Electrification Section (EW10126)
Public Relations Department
Westinghouse Electric Corporation
Box 1017, Pittsburgh 30, Pennsylvania

Please send *free copy* of
"A Rural Community Service Program."

Name.....

Position.....

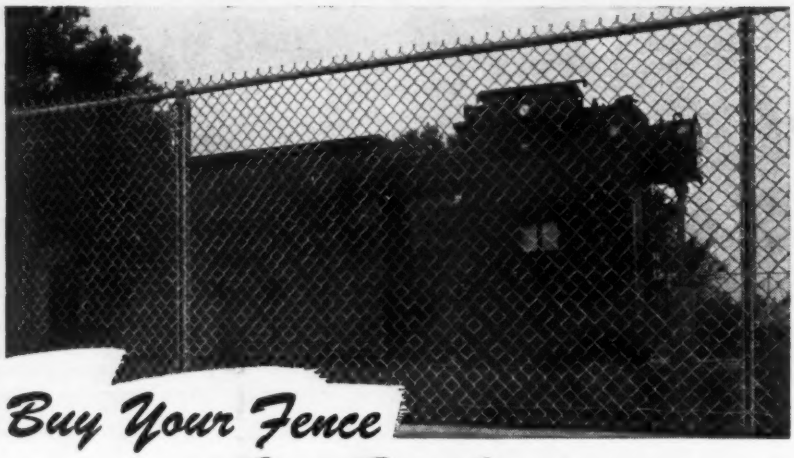
Company.....

Address.....

City.....Zone.....State.....

PAGE FENCE - Since 1883

• AMERICA'S FIRST WIRE FENCE •



Buy Your Fence as You Buy Insurance

● When you choose protection for your property, buy the fence that is best suited to your individual needs. You can have a long-lasting Page Chain Link Fence in a choice of four superior metals, one of which will be best for you: 1. Corrosion-resisting Page Aluminum. 2. Page Copper-Bearing Steel, heavily galvanized. 3. Page-Allegheny Stainless Steel, immune to rust. 4. Page-Armco Ingot Iron, purest commercial ferrous metal. And you can have your fence erected by a nearby fence engineering firm which is long-experienced and reliable. Write to any office listed below for illustrated information.

For name of nearest member firm, write to PAGE FENCE ASSOCIATION in Monessen, Pa., Atlanta, Bridgeport, Chicago, Denver, Detroit, Los Angeles, Philadelphia, Pittsburgh, New York or San Francisco

PRODUCT OF PAGE STEEL & WIRE DIVISION OF AMERICAN CHAIN & CABLE • BRIDGEPORT, CONN.

BIDDLE *SPEED MEASURING INSTRUMENTS*

The "Jagabi" Hand Tachoscope is a combined stop-watch and revolution counter for precise speed measurements. Write for Bulletin 1790-W.

Whatever your speed-measuring problems, it will be to your advantage to consult with us. We offer a variety of centrifugal, chronometric and vibrating-reed instruments. Illustrated bulletins fully descriptive of all types will be sent at your request.

James G. **BIDDLE CO.**

ELECTRICAL & SCIENTIFIC INSTRUMENTS

1316 ARCH STREET • PHILADELPHIA 7, PENNA.

ing department, he developed the fulchronograph for registering the amount of current in a lightning discharge. Later he became interested in solving difficult problems in motion vibration and heat flow by combining electrical units to simulate the physical elements of the problem. During the last few years, he has been in charge of Westinghouse's lightning investigation program and of their transients analysis laboratory as well.

Dr. Melvin K. Kofoid, formerly research engineer at the Westinghouse research laboratory at Pittsburgh, Pa., has entered the electrical engineering department of Oregon State College.

Dr. Philip C. Magnuson, formerly with the General Electric Co. at Schenectady, N. Y., has also joined the electrical engineering staff at Oregon State.

Dr. Walter W. Lewis, General Electric employee since 1907 and transmission engineer at the central station engineering division of the Scnenectady G.E. works, has been appointed professor of electrical engineering at Union College. Dr. Lewis is a specialist in transmission line engineering and is one of America's foremost investigators of lightning, its effects and protection methods. He has discovered numerous improvements in transmission design and protection and is the author of a book on "Transmission Line Engineering". He is a fellow of the American Institute of Electrical Engineers, and a member of CIGRE, international conference on high tension systems.

•

▶ G. L. FURR, for the past three years division manager of the Bluefield division of the Appalachian Electric Power Co., has been promoted to the newly created position of assistant general manager, with headquarters in Roanoke, Va. Mr. Furr has been identified with the electric company in Bluefield for 30 years. He will be succeeded as division manager of the Bluefield division by J. P. GILLS, who has been his assistant for the past three years. Mr. Gills has been connected with the company since 1917.

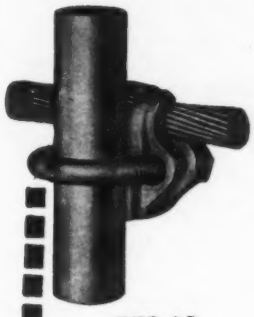
▶ W. R. WOLFE, eastern division manager of the Oklahoma Gas & Electric Co., has been promoted to the position of assistant vice-president of the company. As eastern division manager, he will be succeeded by JOHN T. NAYLON, manager of the company's El Reno district. Mr. Wolfe has been connected with Oklahoma Gas & Electric for 20 years.

▶ J. B. STROTHER has resigned as manager of the Covington Electric Corporation, Alabama REA cooperative, to take

O.Z. KNOWS CONNECTORS

FROM THE GROUND UP

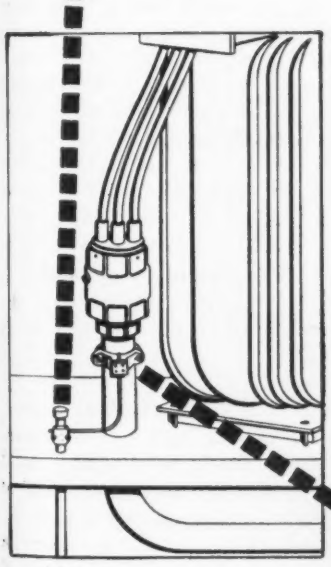
Whether in the depths of a mine or the towers of a skyscraper, wiring jobs done with O.Z. fittings *go in faster . . . stay in longer.* For typical reasons, check the advantages, below, of just two of the many O.Z. ground connectors. You'll see why engineers say— **"They're OK if they're O.Z."**



TYPE AG

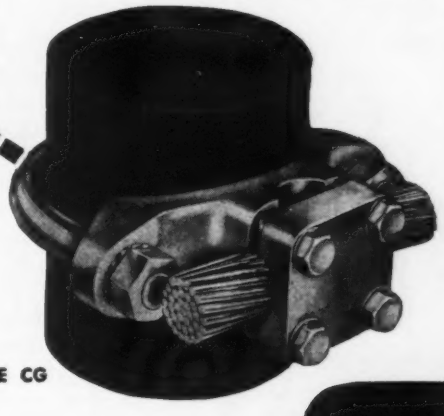
TYPE AG GROUND CONNECTORS

- Top clamp plate is ribbed for strength . . . eliminates distortion.
- High-conductivity copper alloy . . . resists corrosion.
- Interlocking pivoted clamp insures maximum circular pressure.
- Single Everdur U-bolt secures cable to ground rod . . . reduces assembly time.
- Each fitting accommodates a wide range of cable sizes.



TYPE CG GROUND CONNECTORS

- Ground wire connects at right angles or parallel to pipe.
- Universal clamp assures positive contact in either direction.
- High-conductivity copper alloy . . . resists corrosion.
- Everdur U-bolt can be clamped in place on rod or pipe and ground cable fastened as a secondary operation.
- Each fitting accommodates a wide range of wire sizes.



TYPE CG

More and more electrical wholesalers are stocking O. Z. fittings. See your local distributor today. Write us for catalog detailing sizes, features, and prices of the complete O.Z. line.

2024

CONDUIT FITTINGS • CABLE TERMINATORS
CAST IRON BOXES • SOLDERLESS CONNECTORS
GROUNDING DEVICES • POWER CONNECTORS

O.Z. ELECTRICAL MANUFACTURING COMPANY

262 BOND STREET · BROOKLYN, 2 N. Y.

Protect what you have!

CURRENT

—and you won't have to worry about unavailable equipment

SHORT CIRCUIT · MOISTURE · DISINTEGRATION

Model 406

HYPOT

HIGH VOLTAGE INSULATION BREAKDOWN TESTER

Coverage for every requirement of testing for insulation breakdown is now provided by Associated Research's Hypot line. In addition to Models 406—410, 0-3000 volt, Hypot now includes models from 6,000 to 30,000 volts. Instantaneous reading on open scale.

SOON AVAILABLE

A Hypot bench model testing up to 5,000 volts. Write for detailed literature.

There's a need for a Hypot in every plant or institution where electric circuits must be safeguarded. Accurate dependable location of faulty insulation *before* burnouts result in a disaster. Ask for bulletins.

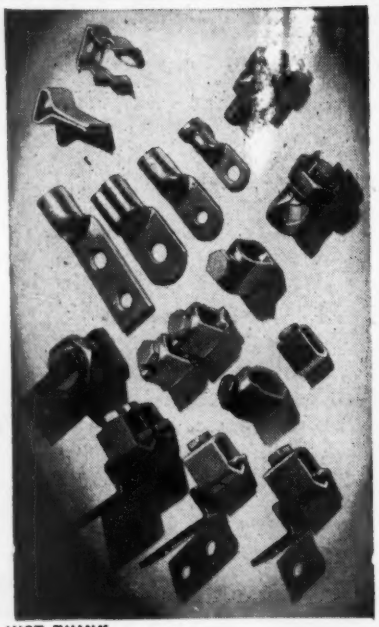
Engineering Service Representatives in all Principal Cities.

ASSOCIATED RESEARCH, INCORPORATED

Also mfrs. of Keeler Polygraph Lie Detector.

221-C S. GREEN ST., CHICAGO 7, ILL., PHONE STATE 5076

ILSCO ELECTRICAL CONNECTORS



JUST THINK . . . . 9 SECONDS FOR A PERFECT CONNECTION

Many millions in actual use . . . because no guesswork . . . no worries . . . no special tools. Economical . . . dependable . . . connectors can be used over and over. ILSCO CONNECTORS are Underwriters' Approved, 99% pure electrolytic copper, 100% conductive.

Write for 48-page illustrated catalog

Name .....

Firm Name .....

Address .....

ILSCO COPPER TUBE & PRODUCTS, Inc.

CINCINNATI, OHIO

PIONEER MFRS. OF Truck Winch & Crane Equipment FOR PUBLIC UTILITIES

1918 - 1946 — Our 28th Year

"Silent Hoist" TRUCK CRANES

With Manual or Power Swing Boom

Write for Catalogs: No. 58 on KRANE KAR No. 60 on Truck Equipment

Truck-motor-power Cranes, unusually compact, from one to 10 tons capacity. "SILENT HOIST" Cranes have features of design which enable safe and easy operation. Deliveries from 60 to 90 days. Agents in principal cities.

THE ORIGINAL SWING BOOM MOBILE CRANE WITH FRONT-WHEEL DRIVE AND REAR-WHEEL STEER

2½, 5, AND 10 TON CAPACITIES

KRANE KAR

TRADE MARK REGISTERED

SILENT HOIST & CRANE CO.

862-63rd ST., BROOKLYN 20, N. Y.

over operation of the Brundidge (Ala.) electric distribution system under a 10 yr. contract. CHARLES GOODWYN took over Mr. Strother's duties with the co-op.

OBITUARY

▶ ARTHUR F. WESTERVELT, retired manager of the contract and inspection department of the Consolidated Edison Co. of New York, died in White Plains, N. Y., on September 14 at the age of 71. A native of Hackensack, N. J., Mr. Westervelt attended Stevens Institute of Technology and joined Consolidated Edison 40 years ago. He retired ten years ago.

▶ CLARK STANDIFORD, president and manager of Ma-Yu Electric Cooperative, Inc., Maricopa and Yuma Counties, Arizona, died on September 23 in Porterville, Calif. Mr. Standiford was born in Galesburg, Ill., 70 years ago.

▶ HERBERT I. FINCH, formerly chairman of the board of directors of the Emerson Electric Manufacturing Co., St. Louis, died on September 27 at his home in that city. He was 71 years of age. Mr. Finch was president of the company before assuming the chairmanship in 1933.

▶ GEORGE ENGELKRAUT, Philadelphia district manager for the Bussmann Mfg. Co., St. Louis, Mo., died on September 5. Mr. Engelkraut has covered the Philadelphia district for Bussmann since 1937. He had formerly been with Franklin Electric Co. of Philadelphia from the time of its organization in 1920. Mr. Engelkraut was active in the affairs of the Electrical Association of Philadelphia.

▶ GEORGE E. HUNTER, 60, long a well-known General Electric sales representative in the supply and central station departments at Boston, died at Holderness, N. H., on September 25. In his early career he was a partner in the electrical firm of Newington & Hunter, Boston; was with the Nernst Lamp Co., Pittsburgh, from 1907 to 1908, and at the Harrison Lamp Works of G.E. from then until 1911. Mr. Hunter was then transferred to Boston and worked in the supply and electric utility fields until his retirement because of poor health in 1941, covering much of northern New England and later having charge of the company's business with New England Power System headquarters at Boston.

▶ ALBERT N. BRIGHT, 60, president of the Haselton Electric Co., Hartford, Conn., died recently at Wethersfield, Conn.

Get the right answer *FAST*—for more efficient more profitable handling of EVERY TYPE OF PRACTICAL ELECTRICAL JOB

Thousands of men have used previous editions of this famous handbook as a working guide of everyday usefulness. Now it is ready to help you too, in a big 5th edition—600 pages larger—brought up to date — *more than ever the one great pocketbook of practical electricity for you*

5th Edition

Croft's AMERICAN ELECTRICIANS' HANDBOOK

Revised by CLIFFORD C. CARR

Head of Electrical Engineering Department Pratt Institute

THIS book is packed from cover to cover with the facts which every man engaged in electrical work needs to have constantly at hand. From clear explanation of the fundamentals of electricity, to suggestions for remedying the troubles of electrical equipment, the information is the kind that helps practical electrical men select and install commercial electrical apparatus and materials intelligently for the performance of specific services, operate electrical equipment efficiently, and maintain it at high operating efficiency.

1600 PAGES OF practical data, helpful pointers, explanatory illustrations and diagrams, useful rules, recommendations, and short cuts, and much descriptive information on modern electrical practice. 5 x 7¼. 1177 illustrations.

PRICE ONLY $5.00

COVERS:

- conductors
- circuits and circuit calculations
- general electrical equipment and batteries
- generators and motors
- transformers
- outside distribution
- interior wiring
- electric lighting
- etc.

10 DAYS' FREE EXAMINATION

McGraw-Hill Book Co., 330 W. 42nd St., N. Y. C. 18

Send me Croft's American Electricians' Handbook for 10 days' examination on approval. In 10 days I will send $5.00 plus few cents postage, or return book postpaid. (Postage paid on cash orders. Same return privilege).

Name .....

Address .....

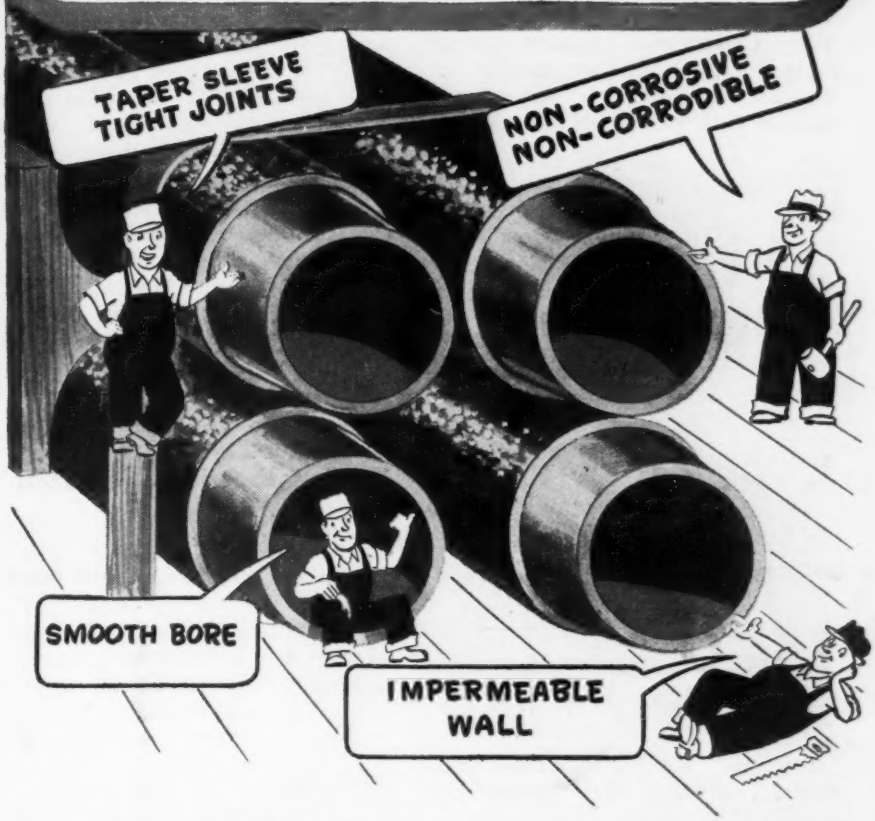
City & State .....

Company .....

Position .....W. 10-12-46

For Canadian prices write Embassy Book Co., 12 Richmond St. E., Toronto 1

WHAT CONDUIT ASSURES LONGER CABLE LIFE?



ORANGEBURG* CONDUIT is the answer. ORANGEBURG has a smoother bore and a low coefficient of friction. There is less chance of abrasion as the cable is pulled into the duct — less possibility of strains from pulling tension—less wear on the sheath from cable movement with changing loads.

Furthermore, ORANGEBURG'S tight taper sleeve joints and impermeable wall prevent infiltration of ground water — protect the cable against corrosive action.

Let us give you complete information on this better conduit. Write for the free catalog today!

THE FIBRE CONDUIT COMPANY • ORANGEBURG, N. Y.

Graybar Electric Co., Inc. • *Distributors* • General Electric Supply Corp.

*Reg. U.S. Pat. Off.

THE FIBRE CONDUIT CO. ORANGEBURG PAT. OFF. ORANGEBURG, N.Y.

ORANGEBURG

WITH 50 YEARS EXPERIENCE IN THE MANUFACTURE OF NON-METALLIC CONDUIT AND PIPE, SERVES THE POWER AND LIGHT, TELEPHONE, GENERAL CONSTRUCTION, CHEMICAL, PETROLEUM, PLUMBING AND BUILDING SUPPLY FIELDS WITH ELECTRICAL FIBRE CONDUIT . . . ELECTRICAL UNDERFLOOR DUCT SYSTEMS . . . AND FIBRE PIPE FOR NON-PRESSURE USES.

MANUFACTURERS & MARKETS

Line Material's New Pole Hardware Plant Opened

Line Material Co.'s new and modern plant at Kansas City, Mo., was formally opened and operations started early last month. The new facilities are designed primarily for making galvanized pole line hardware and specialty items, but future plans include the manufacturing of a wide variety of products.

MANAGER—Schwartz heads works

The factory and office building are completely new, having been erected during the past nine months on a site acquired late last year. The building and equipment are modern throughout. An electrically heated and controlled galvanizing installation is utilized in applying the protective coating on all line construction material items. Part of the building will be used to increase the company's warehouse facilities for serving the Southwest.

The manufacture of pole line hardware at Gary, Ind., has been discontinued and that plant sold. The new Kansas City plant greatly expands the facilities formerly available at Gary. J. B. Schwartz, who for many years managed the Gary operations, is in charge of the new Kansas City works.

This Kansas City installation is the seventh major plant in Line Material's growing chain of manufacturing facilities located throughout the country to serve the electrical utility industry.

•

Lead Allocations Reduced

Total lead allocations for the fourth quarter amount to 212,500 tons, a 20,000-ton drop from the third quarter, the Civilian Production Administration has announced. Domestic production, however, has improved and higher imports are expected, according to the CPA. The drop reflects an attempt to limit licenses to the available supply. During the third quarter, consumers were able to obtain only about 182,000 of the 232,500 tons allocated.

•

Starts Radio Production

Radio-phonograph production has started in Philco Corp.'s new $2,250,000 radio and television plant at Philadelphia. Ground for the plant was broken a year ago.

Japan's Equipment Output Continues at April Level

Japanese electrical manufacturing industry output remained practically constant for the April and May months, according to a report from the Supreme Commander of Allied Powers to the Commerce Department. Those items which did increase were articles needed by the occupying forces. The production figures for the two months are shown in the table.

It was reported, however, that production capacity has increased with the reconstruction of manufacturing facilities within the devastated areas.

Item	April 1946	May 1946
	Number	
Motors		
Fractional HP	4,263	4,929
1 to 15 Hp	8,284	6,906
16 to 100 Hp	446	129
Other motors	1,200	750
Generators, Converters, MG Sets	583	535
Transformers		
Distribution, Power	3,659	2,531
Other	1,818	2,010
Rectifiers, mercury vapor	50	55
Power Condensers	45	75
Furnaces	35	45
Welding Apparatus	520	470
Control Apparatus		
Hand control	3,780	4,550
Remote control	1,765	1,805
Switchboard Apparatus		
Over 3,300 volts	330	500
3,300 volts and under	250	240
For standard motors	500	520
Watt Hour Meters	11,317	11,200
Illumination Equipment		
Fixtures	80,380	65,338
Light Bulbs		
15 to 300 candlepower	2,686,685	3,581,289
Over 300 candlepower	150,516	187,696
Flashlights	484,961	587,338
Wire & Cable, metric tons	2,354	2,467

PLANT—New home of Line Material's pole line hardware operations located at Kansas City, Mo.

PROBLEM:— Installing a stack, dust collectors and dampers on two boilers and providing a bypass around the dust collectors, in the most compact space possible.

One Thermix Stack, serving both units, was connected to the boilers by a straight, short, horizontal breeching. Two SVH Heacon dampers regulated the flow through the dust collectors when partially open and, when fully opened, exposed the bypass. Two Thermix tubular dust collectors were easily installed by suspending them from the stack supports.

These units were all installed on a simple steel structure supported by the four boiler columns.

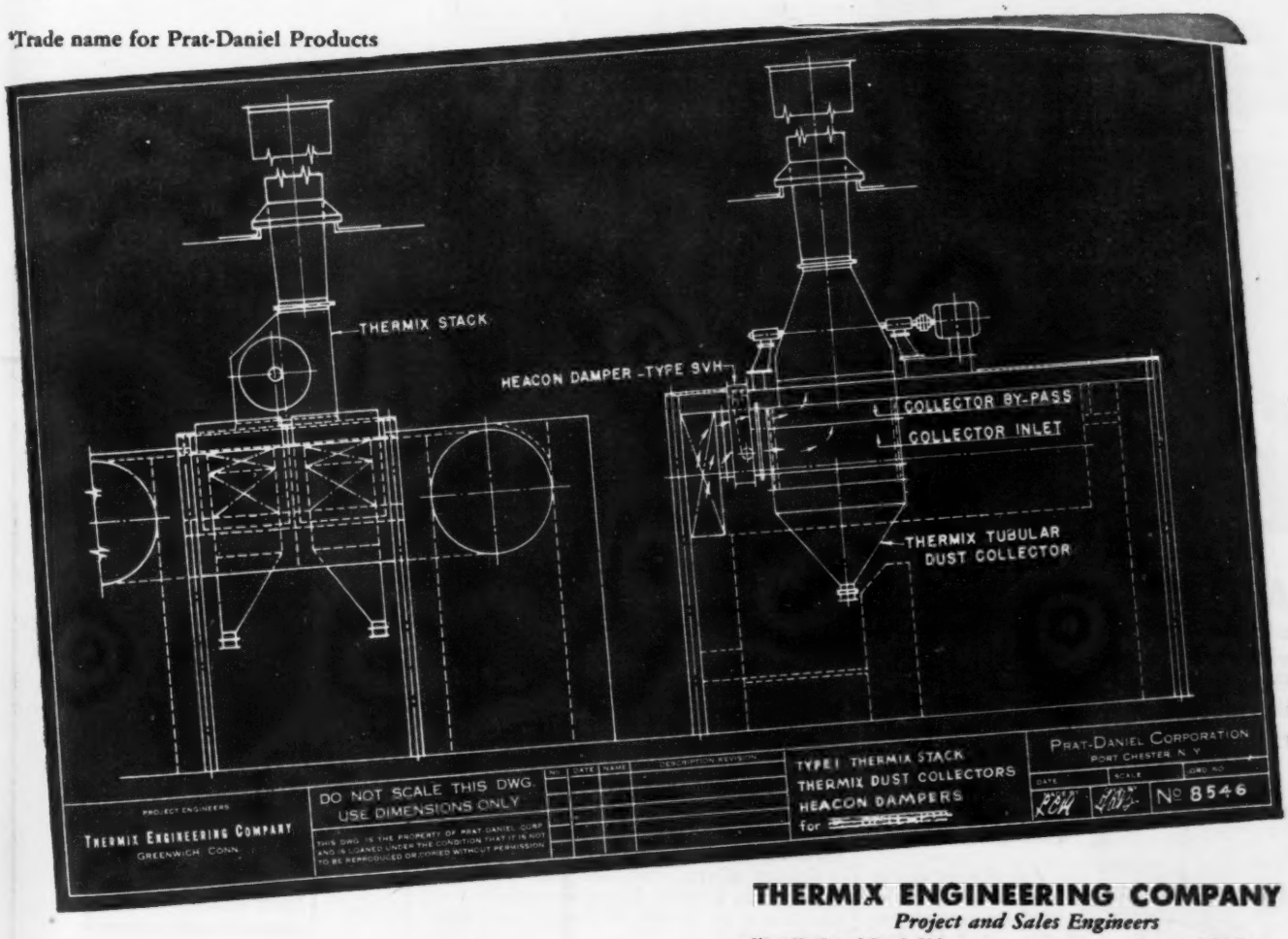
Thermix equipment is designed to simplify installation problems. The Thermix stack, for example, combines a stack breeching and I.D. fan in one integral unit that can be mounted directly on the boiler, or adjacent to the boiler, with a minimum of structural supports and duct work.

Our project engineers can simplify your installation problems. Write or call the office nearest you.

Simple-Direct-Efficient INSTALLATIONS

. . . are possible with "Thermix"* equipment

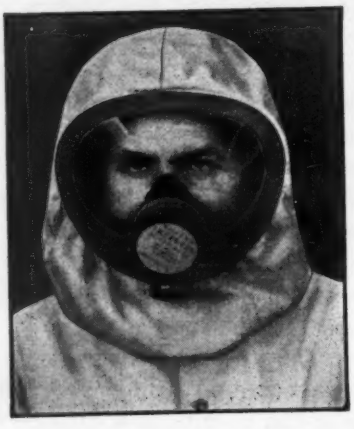
*Trade name for Prat-Daniel Products


THERMIX STACK
HEACON DAMPER -TYPE SVH
COLLECTOR BY-PASS
COLLECTOR INLET
THERMIX TUBULAR DUST COLLECTOR
PROJECT ENGINEERS
THERMIX ENGINEERING COMPANY
GREENWICH, CONN.
DO NOT SCALE THIS DWG. USE DIMENSIONS ONLY
THIS DWG. IS THE PROPERTY OF PRAT-DANIEL CORP. AND IS LOANED UNDER THE CONDITION THAT IT IS NOT TO BE REPRODUCED OR COPIED WITHOUT PERMISSION
NO. DATE NAME DESCRIPTION REVISION
TYPE: THERMIX STACK
THERMIX DUST COLLECTORS
HEACON DAMPERS
for
PRAT-DANIEL CORPORATION
PORT CHESTER, N. Y.
DATE SCALE DWG. NO.
No 8546

THERMIX ENGINEERING COMPANY
Project and Sales Engineers
First National Bank Bldg. Greenwich, Conn.

PRAT-DANIEL CORPORATION

EAST PORT CHESTER, CONN.



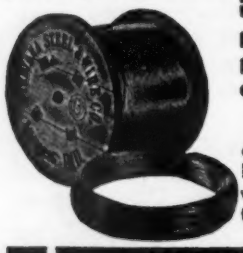
New "Lightweight"
RESPIRATOR HOOD
for Dust and Spray

A practical hood for operations involving fine nuisance dusts and paint spray.
WEIGHS ONLY 9 OUNCES
Incorporates the new design FULL VISION window which is quickly replaced without the use of tools.

WRITE FOR BULLETIN EW-106

IPCO
Safety Equipment for all Industries
INDUSTRIAL PRODUCTS COMPANY
2808 N. FOURTH STREET • PHILADELPHIA 33, PA.

ALL the strength and durability inherent in steel are combined—with definite economies—in *Crapo* Galvanized Steel Strand. Heavy, ductile, tightly-bonded zinc coatings, applied by the famous *Crapo* Galvanizing Process, provide lasting protection against corrosion.



Ask the distributor of *Crapo* Galvanized Products near you or write direct for further information!

INDIANA STEEL & WIRE CO.
MUNCIE, INDIANA

Sangamo Moves Condenser Division to Carbondale

Officials of the Sangamo Electric Co. have announced the condenser division of the Springfield (Ill.) plant will be moved to the Illinois ordnance plant near Carbondale, Ill. Thomas McLerren will take charge of the new plant, which will manufacture meters, tachographs and allied apparatus.

Reason for the move was given as "heavy demands for the company's products in excess of pre-war production." Production schedule calls for additional floor space and a sharp increase in the number of employees.

Most employees of the condenser division will be absorbed by other departments at the local plant.

•

Will Use Aluminum Wire

Because of the current copper shortage United States Rubber Co. has announced that it will substitute aluminum for copper in some of its building wire and cable now going into production. The insulated aluminum wire will be made in all sizes, as approved by Underwriters' Laboratories. Through intensified laboratory research the company has developed aluminum wire with the same over-all diameter as equivalent copper sizes, H. H. Weber, sales manager of the company's wire and cable department, stated.

•

Manufacturers Make Sales Assignments

Electrical manufacturing companies have recently made the following appointments to their sales staffs:

ELECTRIC PRODUCTS CO., Cleveland, has opened a new district office at 424 Boulevard Building, Detroit 2, Mich., headed by E. G. Schroeder. This new district office will handle all sales and service negotiations in the territory, which consists of Michigan, northwestern Ohio and northeastern Indiana. Mr. Schroeder was previously associated with the New York State Electric & Gas Corp. and with the General Electric Co.

EUREKA WILLIAMS CORP., Eureka Division, has appointed J. G. Fisher as Chicago regional and branch manager. Mr. Fisher will have the responsibility of distribution and sales in the seven-state area out of Chicago. Mr. Fisher was recently with Leath & Co., retail furniture chain with headquarters at Chicago, and previous to that was with OPA and Westinghouse Electric Corp.

ELECTROMASTER INC. has named E. I. Jones of E. I. Jones Co. representative for the states of Texas, Louisiana and the southern half of Mississippi. The E. I. Jones Co. maintains offices in the Liberty Bank Building, Dallas, Tex.

FINCH TELECOMMUNICATIONS, INC., New York, manufacturer of facsimile equipment, has appointed Graybar Electric Co. a distributor for all its facsimile products.

EVERSTICK ANCHORS...

FOR SPEED IN INSTALLATION

The exclusive Everstick nut housing locks the Anchor firmly on the rod. This speeds up installation. Plates are so designed, that they expand easily into undisturbed earth, and extra holding power is achieved. Made of tough, rust-resistant malleable iron. Write for bulletin.

EVERSTICK ANCHOR CO.
FAIRFIELD, IOWA

Solves the Problem of Mailing List Maintenance!

Probably no other organization is as well equipped as McGraw-Hill to solve the complicated problem of list maintenance during this period of unparalleled change in industrial personnel.

McGraw-Hill Mailing Lists cover most major industries. They are compiled from exclusive sources, and are based on hundreds of thousands of mail questionnaires and the reports of a nation-wide field staff. All names are guaranteed accurate within 2%.

When planning your direct mail advertising and sales promotion, consider this unique and economical service in relation to your product. Details on request.

McGraw-Hill Publishing Co., Inc.
DIRECT MAIL DIVISION
330 West 42nd St., New York, 18, N. Y.

Find the answers you need— in these 4 McGRAW-HILL Books

See one or all 10 days on approval

REPAIR SHOP DIAGRAMS

and Connecting Tables for Lap-Wound Induction Motors

By **DANIEL H. BRAYMER**, Late Editorial Director, Industrial Engineer, and **A. C. ROE**, Manufacturing Engineer, Manufacturing and Repair Dept., Westinghouse Electric Corp. **Second Edition. 387 pages, 182 figures, 52 tables, 74 charts, $3.50.**

Supplies diagrams and connecting tables for all the different kinds of windings used in motors from 2- to 14-poles, two- and three-phase. Furnishes practical, step-by-step instructions on laying out of coils for induction-motor windings and connecting the ends of the groups of these coils in proper sequence of phase and pole groups.

BASIC ELECTRICAL ENGINEERING

Circuits, Machines, Electronics

By **A. E. FITZGERALD**, Associate Professor of Electrical Engineering, Massachusetts Institute of Technology, **443 pages, 6¾x8¼, 383 illustrations, $3.75.**

Direct and fundamental treatment of electrical engineering, presenting an integrated view of circuit theory, electrical-machinery fundamentals and applications, and engineering electronics. Gives the reader a rapid grasp of working fundamentals from simplest circuit concepts to instrumentation and automatic-control application in research and industry.

TRANSMISSION LINES

Design, Construction and Performance

By **FRED C. DEWEESE**, General Engineer, Carolina Power and Light Company. **297 pages, 5¼x8, 182 illustrations and tables, $3.50.**

Deals exclusively with the design, construction, and day-in, day-out performance of high-voltage transmission lines. An authoritative, easy-to-follow guide to transmission line work, the book presents step-by-step procedures from simple short-line problems through lone high-voltage line problems requiring involved mathematics for their solution.

CONTROLLERS FOR ELECTRIC MOTORS

By **HENRY DUVALL JAMES**, Consulting Engineer, and **LEWIS EDWIN MARKLE**, Design Engineer. **324 pages, 6½x9¾, 276 figures, 6 tables, $4.00.**

A manual on all types of commercial motor controls, describing their construction, performance, and operation, and giving pointers on maintainence, for operating men, application engineers, and purchasers of controls. Gives a wealth of practical information on the safe and efficient control of motors, including helpful explanations and diagrams on electronic tube control, arc rupturing, operation of Amplidyne, etc.

SEND THIS McGRAW-HILL COUPON

for copies 10 days' on approval

McGraw-Hill Book Co., 330 W. 42 St., N.Y.C. 18
Send me the books checked below for 10 days' examination on approval. In 10 days I will pay for books, plus few cents postage, or return books postpaid. (Postage paid on cash orders.)

- ☐ DeWeese—Transmission Lines, $3.50
- ☐ James and Markle—Controllers for Electric Motors, $4.00
- ☐ Fitzgerald—Basic Electrical Engineering, $3.75
- ☐ Braymer and Roe—Repair Shop Diagrams, $3.50

Name .....

Address .....

City and State .....

Company .....

Position .....W. 10-12-46

For Canadian price, write: Embassy Book Co., 12 Richmond St. E., Toronto 1.

HEMINGRAY INSULATORS

Favorably Known Since 1870

Power Insulators You Can Rely On!

Hemingray Insulators are made as you would like to have them made. Under exacting laboratory control!

Every batch of glass—every lot of moulded insulators is checked *hourly,* with various precision instruments.

That's why Hemingray Insulators are so free from flaws, so uniform in quality, so dependable.

There are ten Hemingrays for Primary Power distribution for voltages from 2,300 to 15,000 and manufactured in accordance with suggested specifications of the Edison Electric Institute.

There are ten Hemingrays for Secondary Power distribution with heights ranging from $2\frac{15}{16}$ to $5\frac{1}{32}$ inches and diameters from 2¼ to 3¼ inches.

Investigate! Hemingrays are sold by principal jobbers and are manufactured by Owens-Illinois, Hemingray Division, Muncie, Ind.

OWENS-ILLINOIS

HEMINGRAY INSULATORS

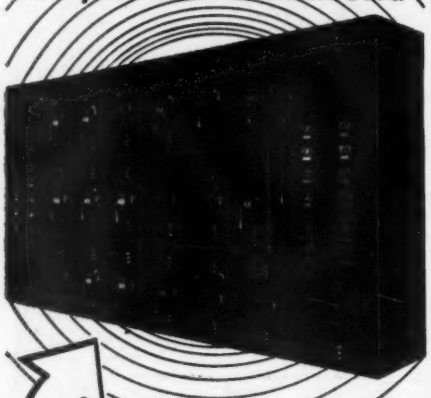
Telephone-Telegraph

Export Agents: International Standard Electric Corporation, New York City

Why it will pay you to try

Pelham

for your next Switchboard



Main Control Switchboard for power and light company. Fully enclosed; dead-front; circuit-breakers throughout. All panels individually hinged.

1. Exceptional Engineering Service. The wide experience of our Engineering Department has included the most difficult problems of switchboard design. We can send an engineer to combine our experience with yours in planning a job.

2. Highest Standards. The wide preference for Pelham Switchboards is largely due to the knowledge of electrical engineers that "Pelham" on a board definitely guarantees the best of materials and workmanship.

3. Unusual Cooperation. We take full responsibility for meeting all specifications of architects and engineers, as well as municipal, state, or federal requirements. Our deliveries are made when promised.

PELHAM ELECTRIC MFG. CORP.
Erie, Pa.

SPECIALIZED DESIGN

Pelham

UNEXCELLED QUALITY

SWITCHBOARDS • PANEL BOARDS
SWITCH GEAR AND ACCESSORIES

Recent Rate Changes

PUBLIC SERVICE ELECTRIC & GAS CO., Newark, N. J., will reduce its electric rates $5,000,000 annually, according to an announcement by the Public Utilities Commission of New Jersey. The new rates become effective November 1. Residential customers will receive $3,000,000 of the decrease and the remaining $2,000,000 will go to commercial and general customers. Comparison of bills for typical amounts of electric service under present and proposed residential rates foliows: monthly use, 25 kw.-hr., present rate, $1.65; reduced rate, $1.52; 50 kw.-hr., $2.65 against $2.33; 100 kw.-hr. $4.15 against $3.83. Reductions in the commercial light and power rate will permit further simplification of the rate structure by eliminating the general service rate. All customers now served under the commercial light and power rate will receive reductions in their bills and bills of all customers served at present under the general service rate will also be reduced as a result of transfers to the revised commercial light and power rate. Customers served at present under the refrigeration rate will be transferred to the revised commercial light and power schedule. Comparison of bills under present and proposed rates for commercial customers follows: monthly use, 50 kw.-hr., present rate, $3.34; reduced rate, $2.90; 100 kw.-hr., $6.00 as compared with $4.92; 200 kw.-hr., $12 compared with $10.02.

KANSAS POWER & LIGHT CO. customers have saved from 2 to 5 percent on their electric bills, effective October 1. The new schedule applies to all residential and commercial billings. In announcing the reduction, D. E. Ackers, president of the utility, stated this is the fourteenth reduction in rates for Topeka since 1928 and the third this year. It is estimated that the saving will be about $250,000 this year.

CENTRAL MAINE POWER CO., Augusta, has announced a new rate for residential service effective October 16. Under the new schedule, the company allows for $1 the use of the first 14 kw.-hr. or less per month; the next 50 at 5 cents each; and all above 65 at 2 cents each. This rate continues the existing storage water heating provision of 1 cent per kilowatt-hour. It is estimated that this will save residential customers about $300,000 annually, which represents a reduction of 4.83 percent in total residence service revenues based on present use.

UNITED ILLUMINATING CO., New Haven and Bridgeport, Conn., has announced a reduction in electric rates to residential and smaller commercial users following negotiations with the State Utilities Commission. The reductions, effective October 1, will save 120,000 customers more than $335,000 a year.

BARNESVILLE, GA., DEPARTMENT OF LIGHT AND WATER has increased electric and water rates to finance $100,000 improvements to the system. Power is purchased at wholesale from Georgia Power Co. Electric rates for residential use were increased from $1.11 for the first 25 kw.-hr. to $1.66 for the first 25 kw.-hr., which amounted to approximately 90 cents increase per customer. There was no change in the remainder of the rate schedule.

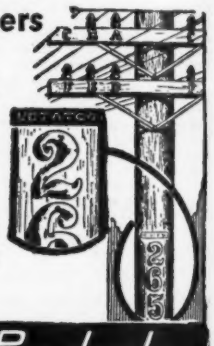
STOUGHTON (WIS.) ELECTRIC UTILITY will reduce electric rates, effective with October billing. The total saving will amount to more than $10,000 a year for residential, rural, commercial and resale users.

DOSSERT CONNECTORS

A one piece heavy duty cable tap. No loose pieces. Cables readily inserted from end or sides as illustrated. *For complete listing of Power connectors send for Catalog 45.*

DOSSERT MANUFACTURING CORP.
249-254 Huron St., Brooklyn, N. Y.

Easy To Identify Premax Markers



There'll be no mistaken identities if poles and lines are marked with Premax Metal Markers. Clear and legible at all times. Send for details.

Premax Products

Division Chisholm-Ryder Co., inc.
4606 Highland Ave. Niagara Falls, N. Y.

CABLE-SPLICERS' WIPING CLOTHS

IMPROVED PATTERNS OF GREATER UTILITY
Formed-flexible Finishing Cloths. Catch Cloths. Crotch Cloths. New Type Cloth for Vertical Joints.

Send for literature and prices.

GEO. E. WILLIAMS, Mfr.
3035 Aldrich Ave. So.
Minneapolis, 8, Minn.

Conductor Fittings

Straight and Parallel Connectors, Cable Taps, Lugs, Tees, Service Connectors, Grounding Clamps, Elbows, etc. etc.

PENN-UNION ELECTRIC CORP.
ERIE, PA.

PENN-UNION

"Say" As Easy As PULLING POLES"

. . . and prove it with Simplex No. 329 Pole Pulling and Straightening Jack. 15-tons Capacity. Height 37¾", lift 22".

A full 15 tons of power enables one or two men to quickly pull or straighten any pole. Also a man-hour saver when moving loaded poles. "I" beam base assures firm footing; tough chain snubs pole. For small poles, No. 325; capacity 5-tons.

Simplex
LEVER SCREW - HYDRAULIC
Jacks

Templeton, Kenly & Co.
Chicago (44), Illinois
Better, Safer Jacks Since 1899

durable!

Galvanized, drop-forged steel!

Mfd. by American Hoist & Derrick Co., St. Paul.

CROSBY CLIPS

BOOK REVIEWS

Equitable Light & Power Rates. By W. R. Tingle. Published by the author, Charlotte, N. C. 60 pages, illustrated. Price $1.

This is not a political discussion of rate equity but an accountant's effort to establish a more scientific rate than any of the discontinuous block rates extant. He achieves a continuous, smooth curve for increasing consumption by applying a fixed (or selective) multiplier which consists of two components, one a so-called pilot factor. Justification is advanced, not in terms of the respective costs to serve, but in the avoidance of any residual inequities in the multiple curve that results from the customary block schedule.

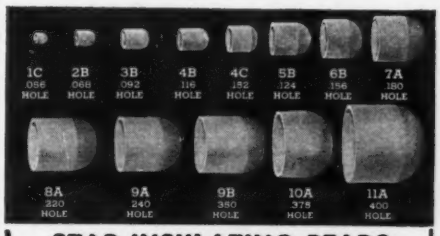
English-French and French-English Technical Dictionary. By Francis Gusset. Published by Chemical Publishing Co., Inc., Brooklyn, N. Y. 590 pages. Price $5.00.

Some 15,000 technical words and phrases are indicated in terms of their equivalents in both directions. These pertain to basic physical science, mechanics, chemistry, metallurgy, mining and electricity. It appears that about one-tenth are terms and expressions used exclusively by electrical engineers and this covers a fair cross-section of such vocabulary. A distinctive feature is the inclusion of more or less idiomatic technical phrases which are the stumbling block for the translator who tries the word-at-a-time conversion. Metric equivalents are given in eight pages of tables in an appendix.

Electric Motor Repair. By Robert Rosenberg. Published by Murray Hill Books, Inc., New York 1, N. Y. 551 pages, illustrated. Price $5.

Written to accompany training courses for repairmen, the treatment is, however, such that an isolated individual should find equal aid in diagnosing troubles with motors and in correcting the defects. With all this treatment goes a fair explanation of the principle of operation of the motors and their controls and accessories. Types covered are: split-phase, capacitor, repulsion, polyphase, universal, shaded-pole and d.c. There is a further chapter on generators, synchros and electronic control.

Something new has been achieved in assembling this dual book inasmuch as the 900 illustrations are spiral-bound on the left of the folder and the 250 pages of text at the right—thus the picture can always face the associated text.

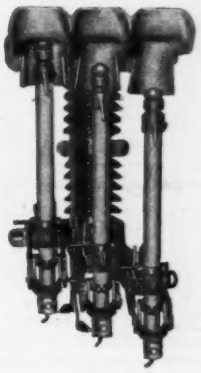


STAR INSULATING BEADS

Use LAVOLAIN ball and socket beads for insulating bare wire. Heat resistant. High di-electric and mechanical strength. Made in U.S.A. Quality beads at low cost. Quickly applied. Flexible. Beads shown above are approximately half actual size. Ask for price list and samples.

STAR PORCELAIN CO.
51 Muirhead Ave. Trenton, N. J.

STAR PORCELAIN COMPANY, Ltd.
49 MAIN ST., TORONTO 14, ONT.



Mistakeproof Reclosers

Here's a provable fact: Order one or more Rural Line Reclosing Matthews Fuswitches on 30 days trial—Freight prepaid.

Give them to a line crew who are familiar with open type dropout cut-outs.

Don't give them any instructions as to how to operate them.

If they are able to sincerely do anything wrong, send them back, freight charges collect, and our bill will be cancelled.

You can't lose. Will you send your order today? Ask for Bulletin.

W. N. MATTHEWS CORPORATION
ST. LOUIS, U. S. A.

PROFESSIONAL SERVICES

Associated Engineers, Inc.

Joseph C. Lewis, President

Management Consultants
Engineering . . Architecture -- - Accounting
Organization - - Methods - - Costs.

230 E. Berry St., Fort Wayne 2, Ind.

ROBERT E. FOLEY CONSTRUCTION CORPORATION

Rural Lines—Transmission Lines
Fire Alarms—Telephone Lines

48 Griswold St. Binghamton, N. Y.

CHAS. T. MAIN, INC.

Engineers

Boston, Mass.

Electric, Steam and Hydraulic Projects. Investigations, Reports, Designs and Appraisals.

BARKER & WHEELER

Utility and Industrial Valuations, Design and Construction of Power Systems, Water Supplies, Sewerage and Sewage Disposal, Factory Production and Cost Control Systems.

11 Park Place, New York City
36 State Street, Albany, N. Y.

FORD, BACON & DAVIS

ENGINEERS

DESIGN • CONSTRUCTION
VALUATIONS • REPORTS

New York • Philadelphia • Chicago • Los Angeles

J. H. MANNING & COMPANY

ENGINEERING SERVICES

120 Broadway, New York

BLACK & VEATCH

Consulting Engineers

Water, Steam and Electric Power Investigations, Design, Supervision of Construction, Valuation, Tests and Laboratory Service.

4706 Broadway, Kansas City, Mo.

PAUL E. GERST & CO.

CONSULTING ENGINEERS

Specialists in
Electrical Product Design
El. Machinery, Apparatus & Applications
El. Appliances, Hi-Frequency Apparatus
Electronics, Radio Communications.

205 W. Wacker Dr. Chicago 6, Ill.

DANIEL W. MEAD F. W. SCHEIDENHELM

Consulting Engineers

Hydro-Electric Development, Dams, Water Supply, Flood Control, Engineering Problems relating to Water Rights and Water Power Law. Appraisals.

New York City, 50 Church St.

E. J. CHENEY AND CO.

ENGINEERS AND CONSULTANTS

Economic and Business Surveys
Valuations and Reports
Rate and Rate Case Analyses

61 Broadway New York

GILBERT ASSOCIATES, Inc.

Engineers and Consultants

DESIGN, CONSTRUCT, OPERATE & MAINTAIN INDUSTRIALS AND PUBLIC UTILITIES

Reports • Rates • Labor relations • Safety • Purchasing • Costs • Laboratory

61 Broadway Reading 17 & Sansom
New York Pa. Phila., Pa.
1417 K St. N.W. Washington, D. C.

ARTHUR L. MULLERGREN

Engineering-Management

Public Utilities—Natural Gas

Kansas City, Mo.

HUGH L. COOPER & CO. INC.

General Hydraulic Engineering, including the design, financing, construction and management of hydro-electric power plants.

350 Fifth Avenue New York 1, N. Y.

RAYBURN M. HAMILTON

Professional Engineer

711 Scanlon Bldg. Houston, Texas

PUBLIC UTILITY ENGINEERING & SERVICE CORPORATION

Consulting Engineers
Design Operations
Steam—Hydraulic—Gas

231 S. La Salle St. Chicago 4, Ill.

DAY & ZIMMERMANN, Inc.

ENGINEERS

Design - Construction - Management
Investigations and Reports

NEW YORK PHILADELPHIA Packard Building CHICAGO

FREDERIC R. HARRIS, INC.

ENGINEERS CONSTRUCTORS

MANAGEMENT
NEW YORK

Knoxville Houston San Francisco

Recording & Statistical Corp.

BILL ANALYSIS—CONSUMPTION STUDIES
THE ONE-STEP METHOD
Bill Frequency Analyzer

102 Maiden Lane New York

DOBLE ENGINEERING COMPANY

Electrical Insulation Engineers

Field Testing and Maintenance of High Tension Insulation, Special Problems in Electrical Communications.

Office and Laboratory: Medford Hillside, Boston, Mass.

Branch Office: 20 N. Wacker Dr. Chicago, Ill.

HENKELS & McCOY

(Electric & Telephone Line Construction Co.)

Wood pole transmission lines
Electric Distribution and maintenance

Philadelphia, Pa.

SANDERSON & PORTER

ENGINEERS

AND

CONSTRUCTORS

Ebasco Services Incorporated

Design and Construction
Financial and Operating Consultation
Investigations and Reports
Consulting Engineering

Two Rector Street New York

HOOSIER ENGINEERING COMPANY

Erecting Engineers
Transmission Lines, Substations

46 So. 5th St., Columbus, Ohio
327 South LaSalle Street, Chicago, Ill.
136 Liberty St., New York

SARGENT & LUNDY

ENGINEERS

140 South Dearborn St.

Chicago, Ill.

ELECTRICAL TESTING LABORATORIES INC.

Specializing in
TECHNICAL SERVICES
to those intent upon good quality

2 East End Avenue at 79th St., New York 21, N.Y.

WILLIAM S. LEFFLER

succeeding
CHARLES F. LACOMBE—WILLIAM S. LEFFLER
Engineers—Economists
RATE RESEARCH — SALES RESEARCH
FOR
POST-WAR PLANNING
Cost Analysis Rate Cases
Noroton, Connecticut

THE J. G. WHITE ENGINEERING CORPORATION

Design • Construction • Reports • Appraisals

80 Broad Street, New York 4

H. F. FERGUSON

Consulting Electrical Engineer

Expert advice on location and purchase of right of way.
Industrial plant layouts & surveys. Rate comparisons.

288 Alameda Avenue Youngstown, Ohio

LUCAS & LUICK

ENGINEERS

DESIGN, CONSTRUCTION SUPERVISION, OPERATION, MANAGEMENT, APPRAISALS, INVESTIGATIONS, REPORTS, RATES

231 S. LaSalle St., Chicago

WHITMAN, REQUARDT AND ASSOCIATES

ENGINEERS — CONSULTANTS
Power Plants — Industrial Plants
Steam and Electric Distribution Systems
Waterworks and Sewerage
Reports—Plans—Supervision—Appraisals

1304 St. Paul Street Baltimore 2, Md.